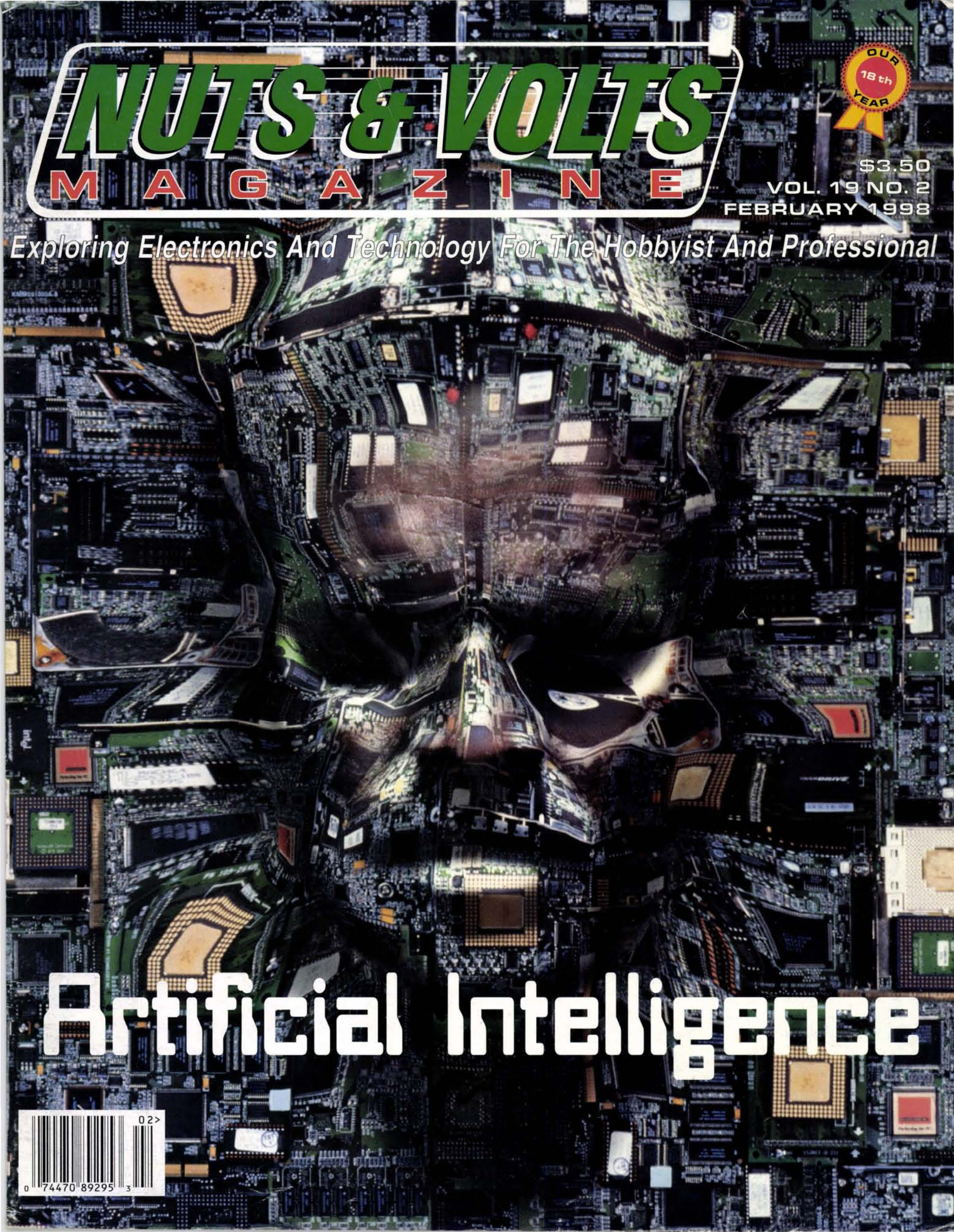
NUTS & VOLTS
MAGAZINE

OUR 18th YEAR

$3.50
VOL. 19 NO. 2
FEBRUARY 1998

Exploring Electronics And Technology For The Hobbyist And Professional



Artificial Intelligence

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STAND ALONE DRIVE DUPE-IT! CLONES ENTIRE DRIVES

Copy entire hard drives with ease. Why spend hours installing and formatting drives when you can do it instantly with Drive Dupe-It! Set up any SCSI or IDE drive with all your original software. Connect blank drives and press start. You'll copy entire drives instantly!

With our combo IDE/SCSI model, you can copy entire hard disk images from IDE to SCSI or vice-versa.

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Choose the Dupe-It Pro, and you'll also have an entire factory drive test system for under $1000. The Pro model gives you the ability to copy, reformat, repair, translate, and test any hard disk drive. Use the Pro to put any hard drive through its paces. A full factory final test and performance analysis is performed. Complete test and repair reports are sent to any standard printer.

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P/N IDI ..... $395.

COMBO IDE AND SCSI DUPE-IT WITH TRANSLATOR
P/N SDI2 ..... $795.

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P/N SDIPRO ..... $995.

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CD DUPE-IT! IS SOLD AND INTENDED FOR BACKUP AND IN-HOUSE DUPLICATION PURPOSES ONLY. COPYRIGHT LAWS MUST BE OBSERVED. CALL FOR RACK MOUNT AND MULTI-DRIVE COPIERS.

COPY ANY CD INSTANTLY!

CD DUPE-IT!

Instantly duplicate master CDs for software distribution. Make spare backup copies of your favorite software on rugged, permanent media. Produce custom discs quickly and economically. No mastering or multimedia experience is required.

ONE BUTTON OPERATION. NO PC NEEDED.

Insert your original disc and press "start". The multimedia processor quickly copies any CD to the internal A/V hard drive. Insert blank discs and make as many copies as you like. You'll produce identical, bit-for-bit duplicates. The system is totally self contained — no computer is needed. Just plug it in and press "start". You'll get perfect copies of any CD.

BUILD YOUR OWN CUSTOM AUDIO DISCS!

You can make your own custom audio discs without a PC! Insert your original CDs, select the tracks you want, and copy them. Then insert a blank CD-R, and you'll have a custom audio disc with just the songs you want.

With the included CD mastering software, CD Dupe-It will work overtime. Just attach a SCSI cable to your PC or Mac, and you're ready to design and create your own original CDs.

CD DUPE-IT! ..... $1095.
CASE OF 100 BLANK DISCS (Green/Gold) ..... $159.
CASE OF 100 BLANK DISCS (Gold/Gold) ..... $199.

Write in 211 on Reader Service Card.

HSC Electronic Supply

Serving Silicon Valley since 1964!

...brings you a potpourri of high-tech goodies for the techno-tinkerer!
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Four styles to choose from:

Diamond Multimedia Wavetable Sound Card
- IDE interface for CD/ROM drive
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MediaVision Premium 3D Sound Card
- 16-bit audio, 44.1KHz digitized stereo sound
- MPU 401 MIDI, Soundblaster compat., SRS 3-D circuitry
- Internal SCSI-2 CD-ROM port, microphone jack (mike not included), line-in & speaker jacks, joystick port
- Includes driver disks, instruction sheet
- OEM package (no box), 90-day HSC warranty
- We had these and ran out...New stock at Lower Price!

HSC#17035 **$29.95**

MediaVision ProZonic Sound Card
- IDE interface for CD/ROM drive
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- Includes driver disks, photocopied book

HSC#17028 **$13.95**

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- 16-bit audio, 44.1KHz stereo sound
- MPU 401 MIDI emulation, Soundblaster compatible
- Internal SCSI CD-ROM port, microphone jack (mike not included), line-in, speaker jack, joystick port
- Includes driver disk, information sheet (no book)
- OEM package (no box), 90-day warranty

HSC#17059 **$19.95**

Rugged On-The-Go Palmtop Computer!

Water-resistant, humidity tested.
Shock/drop test rated from 3+ feet.
Weighs only 3.35 lbs, with battery.
Brand new!

- Kalidor Model K2100 with 640 x 480 VGA LCD.
- Dot pitch 0.23mm, screen size: 5.98" x 4.46"
- 9.7"Long x 6.4" Wide x 1.8" High.
- Pressure-sensitive screen for pencomputing.
- TI486SXLC-25MHz processor.
- 170MB Hard drive, 256KB flash memory
- 8MB RAM - expandable to 16MB
- Advanced nickel-metal hydride battery, 2 hrs. cont. use.
- Recharge time as little as 2 hours!
- Power mgmt. system can give 6 to 8 hour operation.
- 1-Serial port (9-pin), 1-Parallel port (20-pin Cent.)
- IBM PC-AT compatible with DOS and Windows 3.1 installed.
- New, in box with manual, AC adapter/charger.
- 30-Day Warranty.

Recently listed elsewhere at $3600!!

HSC# 17116 **$399.00**

Internet Digital Camera!

Plugs into PC Parallel Port! ***Motion and Still Video Capture***

- Compro 'D-Cam' Color Digital Camera.
- No Video Capturing Card or power adapter needed!
- Great for video conferencing, web page building, family photos, hobby applications...so much more!
- Adjustable focus down to 40mm. (less than 2"!)
- 16.8 Million true color/256 gray scale.
- Windows 3.x, Windows 95 compatible
- Installation software, instructions included

HSC#17090 **$99.00!**

Phone Voice Scrambler

- Privacy at the push of a button -- SecureTalk by GRE!
- Advanced circuitry encrypts telephone conversations from casual eavesdropping, including scanners!
- Small, portable units operate off AC adapter (Land-line model) or cigarette lighter plug (Cellular model).
- Measures 7" x 4" x 1.5", operates on 9 -12 VDC
- Provides a choice of 32 different scrambling codes over 4 channels. Can be bypassed by pressing "Normal" button.
- Sold in pairs, choose AC operation, mobile, or one of each.
- Unit inserts between handset and base of phone (Note, will not work with slim-line or other all-in-one-piece phones!)
- Unit has DB-9 connectors, includes kit of parts to fabricate an adapter cable set (DB-9 male & female to mini-modular connectors, diagram provided) or provide your own parts and save $5
- Both styles are identical except for power adapter and one jumper.
- Units are new in box, 90-day warranty - exchange

HSC# 16909 Land-Line model, HSC# 16910 Cellular model

Your Choice - any two, any style for $29.95/pr.

Special savings offer! Order without parts kit for $24.95

Colossal CD Pack!

- CD-ROM extravaganza for Windows 3.1/95 (except #9)
- Ten titles bundled in one handy folder...something for every member of the family:
  - 1997 Grolier Encyclopedia -- over 50,00 entries, illustrations, Internet links, and comprehensive Atlas.
  - Automobile Almanac -- Research over 200 car models from around the world...reviews, photos, specs.
  - Internet Online -- Software & training to become a skilled Net-Surfer in no time!
  - The Animals 2.0 -- contains over 120 full motion videos, hundreds of photos and CD quality sound
  - The Real Deal -- ten classic card games, including Whist, Pinochle, Hearts and Crazy Eights
  - Home Office Assistant -- business resource directories for prospecting clients, locating parts, etc.
  - Family Dictionary -- Learn vocabulary, word games, 500 color illustrations, 200 animations
  - Reference Library -- Dictionary, Almanac, Thesaurus, Encyclopedia, many more useful references
  - Al Unser Jr. Arcade Racing -- join Indy 500 winner for the ride of your life! (Win95 only)
  - Cyberspeed - high-tech, high-velocity motor race game of the future...hold on to your joystick!

HSC#17127 **$24.95**

Hands-Free Communication!

- Plantronics stereo headset with mini boom-microphone
- New in box, lists for over $100!.
- High quality units for long-term use
- Handy for office or home
- Dual mini stereo plugs connect to many sound cards, etc.
- Hurry, these won't last long!

HSC#17084 **$24.95**

Function Generator Deal!

- Used Wavetek 182 Function Generator
- .2 Hz to 2 MHz, sine, square & sawtooth wave
- Triggered input, DC offset control
- Not test bench should be without one!
- High quality name brand test equipment
- Used, tested good, 30-day warranty

HSC#93637 **$179.95**

House that Equipment!

- Bargain on used, knee high 19" rack cabinets!
- 29.5" tall, with room for 21" of vertical instrument height
- 23.25" wide, and 30" front-to-back, textured black finish
- Made by AMCO Engineering
- Units are used, but in good shape
- Best if you pick up (cannot go UPS)
- Last time we had these at $149.00, and they went fast! Quantity discounts available.

HSC# 17069 **$99.00**

Absolute Last of the Red Hot Reno!

- Now at clearance price -- Media Vision ***Reno***:
  - Consists of new external Reno CD/ROM drive,docking bay with SCSI2 port, AC Adapter, cable kit, travel pouch, headphones
  - Late Model version Uses AC adaptor (included) or AA alkaline batteries (not included)
  - Double-speed 180mS drive is lightning fast!
  - Drive detaches from docking bay, use with headphones as a portable personal audio CD player
  - Great for Mac or IBM (adaptor bracket included)
  - Mac software included
  - SCSI Controller & software required for IBM use
  - Brand new, 90-day warran^

A. 

Now - $59.00

Available Separately:
A. Macintosh Powerbook SCSI Adapter (HDI-30 to 25-pin D connector) **HSC#15704 $12.50** if purchased alone, or with purchase of Reno Kit,**$5.00**

Super Sounding Speakers!

Tired of the cheesy sound coming from those give-away speakers in your multimedia kit? Try upgrading to these sonic wonders...you'll have to hear them to appreciate the difference these will make without blowing your budget!

GNT2500 2-way Bass-Reflex speakers
- 3.5" woofer, 1" piezo tweeter
- 15W built-in amplifiers, 80W peak, 5.4W RMS
- 40 - 20,000 Hz, built-in SRS 3-D stereo
- Measure approx. 3.75" x 6.125" x 9.25" tall
- AC adaptor, audio cables included
- On-off switch, 3-D switch, tone & volume controls
- Attractive off-white finish with grey grille-cloth

HSC#16670 **$29.95**

GNT3000 3-way Bass-Reflex speakers
- 4" woofer, 2" midrange, 1" piezo tweeter
- 23W built-in amplifiers, 120W peak, 20W RMS
- 20 - 20,000 Hz, similar to GNT3500, but no SRS 3-D
- Measure approx. 6.25" x 6.5" x 9.75" tall
- AC adaptor, audio cables included
- On-off switch, bass, treble & volume controls
- Attractive off-white finish with grey grille-cloth

HSC#17085 **$39.95**

SCSI Device Cases

16575 **16960**

Useful cases for your computer when you run out of drive room in your main case! These will accommodate many types of SCSI drives, from CD-ROM, hard disk, tape, ZIP, etc.

- Deluxe quality case, 7" x 4.5" x 10.75", made for Olympus Optical, has 5.25" open front bay, SCSI diagnostic indicator on rear panel, 30 watt fan-cooled power supply, IEC power cord included. Assembled in USA.
  HSC#16575 **$49.95**
- Small horizontal case, 6.5" x 2" x 8.5", for 3.5" drives, small 17 watt fan-cooled power supply (5V @ 1A, 12V @ 1A)
  HSC#16960 **$37.95**

All cases are new, and feature 50-pin Centronics-style daisy-chain connectors, internal 50-pin cable and SCSI ID switch.

Bargain Game Controller!

- Quickshot QS-191 Game pad for IBM Compatibles
- Faster action, less fatigue than a joystick
- Why pay more for a game device?
- Brand new, plugs into 15-pin game port

HSC#17054 **$3.95**

Media Vision PCMCIA Sound!

- Great for Portables, Laptops with PCMCIA Slot
- External pod has joystick port, mic. input, line in & line out jacks, volume control.
- Installation software, instructions included
- Windows 3.x, Windows 95 compatible
- New in OEM packaging (no box), 90-day HSC warranty
- We had these before at $39.95 and they went fast!

HSC#17036 **$29.95**

Spill-Resistant Keyboard!

- Keypad has sheild to protect keyswitch & electronics.
- 101-key keyboard has standard QWERTY layout
- Coiled cord with standard 5-pin DIN connector
- Brand new, 90-day warranty
- Similar to illustration

HSC#17088 **$14.95**

Bargain PCs and VGA Monitors !

- Just arrived!...20 pallets of great buys.
- 486-based Compac and and IBM systems.
- Various configurations, removed from service.
- Refurbished VGA monitors from $89.00!
- Perfect for second system or students/families!

Hurry!...these won't last long!!

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- Pay us a virtual visit on the World Wide Web!
- Simply point your browser to *http://www.halted.com*
- Site is constantly being revised, please visit often!
- Check out the amazing "Gizmo of the Week" feature!

New HSC Catalog !

- Hot off the presses! First one in four years! The wait is over!
- Seventy-six pages of electronics, from ordinary to exotic!
- Phone, fax, write or email to get your copy
- Or drop on by and pick one up...we'd love to see you!

Terms: Some quantities limited; all items subject to prior sale. **Minimum order: $10.00 plus shipping.** Orders under $20.00 subject to $2.00 handling fee, in addition to shipping. All orders shipped FOB Santa Clara, CA (this means you pay freight!) by UPS Surface (no P.O. Boxes) unless otherwise specified, in which case prevailing carrier rate plus $5.00 handling fee applies. Prepaid orders that don't include shipping charges will be shipped freight COD. There is a $4.75 UPS charge added to shipping charges for COD shipments. If you have questions about your order, please call Customer Service at (408) 732-1854 M-F 9AM to 5PM PST.

Write in 131 on Reader Service Card.

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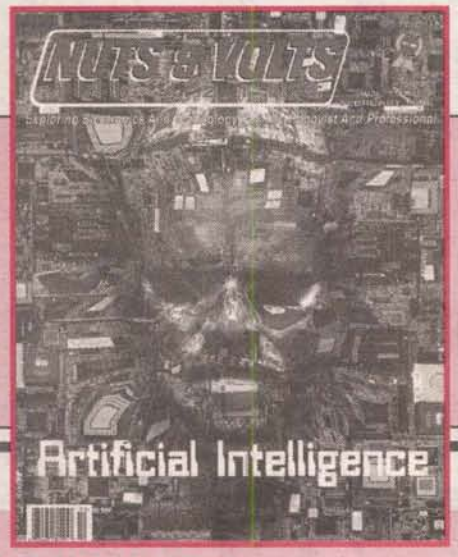

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The closing date for each issue is the 10th of the prior month, e.g., the closing date for the June issue is May 10th. Ad copy to be typeset by Nuts & Volts should be received one week prior to the closing date.

Call or write for current advertising rates.

Nuts & Volts Magazine is published monthly for $19.00 per year by T&L Publications, Inc., 430 Princeland Court, Corona, CA. Application to mail at 2nd class postage rates is pending at Corona and San Diego. POSTMASTER: Send address changes to Nuts & Volts Magazine, 430 Princeland Court, Corona, CA 91719.

reader FeedBack

Dear Nuts & Volts:

Your magazine is good, but it could be improved a lot more.

I would like to see more descriptions and more details on accessories for scanners, CB radios, and radar detectors, of which your magazine Vol. 18 #12 dosen't have any in at all.

It also doesn't have any light-bulb parts in miniature 222-types etc.

Arnaud Milner
French Settlement, LA

Dear Nuts & Volts:

I have one bit of constructive criticism regarding some of your advertisers.

Change your ad if you want anyone to read or respond to it. Some of them have gone unchanged for years. If you frequently list lots of equipment, put each item on its own line. I know it costs more, but a lot of us can't figure out what you are selling and how much you are asking. Sure, it will cost a bit more, but in the long run, I think you will benefit.

I occasionally need a piece of test equipment, but there is no way I am going to re-read the whole section to find it.

Regarding the magazine, I especially like the Stamp Application columns, especially if they include programming samples.

I learned spagetti basic, and am interested in learning tiny C and Forth. Some articles on them would be appreciated.

My other favorites are the robotics, ham radio, audio amps, Tech Forum, Q & A, and others.

Ideas for columns or series include Win 95, software bugs and fixes, hardware and software to avoid, etc.

Thanks again for a really fine magazine. Since *Elector Electronics US* closed up shop, this is the only one I read from cover to cover. Again, that would be more fun if some of the advertisers upgraded their copy occasionally, at least once a quarter. Keep up the good job.

Roger Sahlin

Dear Nuts & Volts:

I would like to thank you for answering my request for a subscription to *Nuts & Volts.*

I cannot wait for the students to read the article, "Robot Wars 1997: Pretty Hate Machine." They are extremely interested in the robot wars ever since I showed them a video clip I recorded from television. I am hoping to find a sponsor or sponsors to help fund a smaller version of the robot wars in my classroom.

Thelma Kastl
West Jefferson, NC

Dear Nuts & Volts:

Excellent magazine! I would like to see an article on electronic watches. How to adjust them, modify them, etc.

Can we tweak cheap watches to high accuracy?

I would also like an article on adding a cheap digital frequency readout to analog portable shortwave radios.

W. Martin
St. Louis, MO

The QUALITY you DESERVE PRICES you can AFFORD

CHECK THIS OUT! ULTRA MINI and WEATHERPROOF,

"LIPSTICK" camera sets new standards. Sleek black anodized, aluminum, housing is O-Ring sealed and RAINPROOF. Adjustable tilting mount included. Specs: 1/3" CCD, 380 Lines resolution, 0.3 Lux sensitivity, AGC, Auto Shutter. Operates on 9 to 16VDC @100mA, 3.7mm, 78° FOV lens, A real glass lens. NTSC video out. 1/2 once! SENSITIVE to IR. Ultra small Size only: 23mm diam. X 50mm long. With 36" leads.
GM-200K-STD,..$129 power adapter .$4.95

"EMBEDABLE", PINHOLE LENS, "BULLET CAM" it's INCREDIBLE !

So tiny you can install it right into a door with merely an 0.9" diameter hole. Sleek black anodized, extruded aluminum housing. Similar construction as the lipstick camera above only smaller! 1/3" CCD, 410 Lines Res., 0.3 Lux sens., AGC, Auto Shutter. Power from 9 to 16VDC @100mA, 250k PIXELS, 90° FOV Pinhole lens. A real glass lens. Std. NTSC video out. 1/2 once! SENSITIVE to IR. Size only 23mm Diam. x 35mm long. With 36" leads. Think of the places you could put this little jewel. **GM-200K-PH lens,..$129 Pwr. module $4.95**

NEW MODEL MICRO CAMERA, w/audio 1/3" CCD, 410 Lines

Res., 0.3 Lux sens., AGC, Auto Shutter. Power from 9 to 16VDC @100mA, 250k PIXELS, Std. model, 3.6mm, 92° FOV lens, Pinhole, 90° FOV. A real glass lens. Both focus from 10mm to infinity. Std. NTSC video out. 1/2 once! SENSITIVE to IR. Size Std: 1.25"sq. x 1"d. PH is 0.6"d, Both with 6" leads. **WARNING:** Don't confuse these models with LOW RESOLUTION, HIGH LUX C-MOS CAMERAS. **C-MOUNT** model now available. Only 0.9" d

GM-1000A-STANDARD..$89 GM-1000A-STD/Audio.....$109
GM-1000A-PINHOLE.....$89 GM-1000A-PINHOLE/Audio...$109
GM-1000A-C-MOUNT...$89 GM-1000A-C-MOUNT/Audio.$109

We offer a complete line of micro lenses for board cams!

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12mm, 28°.....$24	5mm, 70°PH.....$22

SEE in TOTAL DARKNESS! WEATHER PROOF! InfraRed SPOT or FLOOD!

Architectural bronze colored aluminum housing. Tilt and swivel adjustable. Can be mounted to any std,. electrical box, as well as pole or ground mounted. Halogen powered. 60Watt, 110VAC, Military quality IR filter. Projects up to 50 feet. Size only 3"Diam. x9"L including base. Specify spot or flood. **High Power IR Source.....$159**

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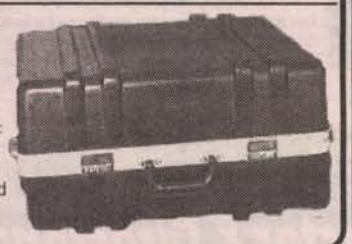

Sharp!, Black high density polyethelene. Scratch & dent resistant. Alum. frame with four locking latches. (with key) Size: 24"W x 20"D x 13"H., Inside foam cutout: 19"W x 13.5"D x 8"H. Foam can be cut. Center & end handles. Weight: 16 lbs. Your delicate equipment will looking and working like new!
REG...$225ea NOW.... $59ea.

PANASONIC WV-D5000 DIGITAL, PROFESSIONAL, COLOR CCD CAMERA

- 2/3" CCD
- 8X f1.4 Zoom Lens
- Auto Focus
- Manual Zoom
- Stereo Mic Inputs
- Standard Composite (NTSC) Output
- Auto/Man White Bal.
- Auto/Manual Iris
- 10.5 to 84mm W/ Macro
- 3 Step AGC
- Earphone Output
- Makes an excellent color "Stake Out" Camera!

These cameras were used for very high end tele-conferencing. They are in excellent condition. Specs: S/N: 46dB, Auto tracing white balance. Minimum illumination 7 lux. They operate from 12VDC @ 0.5 to 1.5A peak. Size including lens is 10.75L x 4.5"W x 4.5"H. Provides 380 lines resolution. Fixed sutter @1/1000 sec. for clear video of fast moving imagery. Supplied with user manual. CA-10 cable and Panasonic power supply is available. Power unit provides video and audio outputs as well!
A very impressive camera system.
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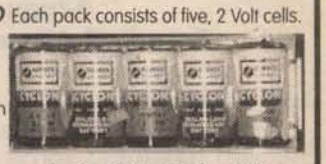

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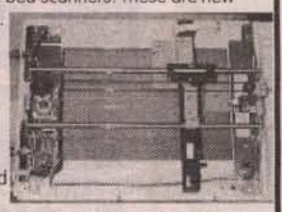

Power is provided by a stepper motor with a toothed belt drive. This moves the carriage 12" accross two polished stainless steel rails. The assembly is mounted to the scanner cover. We recommend removing it and mounting it on your base. Includes optical end of travel detector. Overall size: 16"L x 13"w x 2"H. Nicely made. **Model LMB-2..... $59ea. or 2 for $99**

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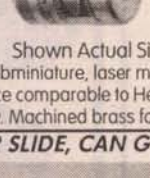

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Software Wizardry

Tracking Visitors to Your Web Site

By Harry Helms

One of the big advantages of the Web over print or broadcasting is how much you can find out about visitors to a Web site. Print publishers have to rely on reader surveys to learn about their audience, while broadcasters depend upon ratings. Both methods depend upon audience samples and are subject to significant error. (For example, how carefully do participants in broadcast ratings fill out their ratings logbooks?) But with the Web, you can know exactly who visits your site, which pages of your site are most popular, and even which browsers visitors use. And this is all done automatically – every time you visit a Web site, you leave a lot of data about yourself behind.

If you'd like a sample of the sort of data that can be collected from visitors to a Web site, drop by www.13x.com/cgi-bin/cdt/snoop.pl sometime. This is a Web site devoted to Internet privacy issues, and it will display data about you, like what type of operating system you're using and your approximate geographical location, that is freely available to the operator of any Web site you visit.

The reason why so much data is freely available about Web site visitors is inherent in the way the Internet/Web is organized and works. However, the availability of this data is not a real threat to individual privacy and actually lets Web site operators better serve visitors.

For example, a Web site operator can know precisely which pages on a site are the most and least popular, and can alter site content according to what visitors really like. Data about the geographical location of visitors allows for further "fine tuning" of site content. It is also possible to determine such data as when people visit the site, which allows a site to be updated each day before most visitors arrive.

In short, tracking data about visitors to your Web site lets you produce a better Web site for them.

Let's take a look at how such data about visitors is made available to a Web site and the ways such data can be compiled and used.

Internet Protocols and Addressing

Every computer on the Internet has its own unique internet protocol (IP) address. An IP address identifies a specific computer, not an individual; there is no way to determine the identity of the person using a computer associated with a specific IP address.

IP addresses are numeric in the format of 123.456.789.000. Since numeric IP addresses are unwieldy for humans to remember and use (computers don't have this problem!), domain names are used instead. A domain name is something that humans can easily use, like www.microsoft.com, and a computer handles the task of translating a domain name into its equivalent IP address.

If you access the Web through an Internet service provider (ISP), your IP address is derived from the domain of your ISP. Let's suppose that you use America OnLine. In such a case, your domain name would be that of America OnLine. Your PC would be treated like a node on a network called America OnLine. When a distant server tries to access your PC, it will use America OnLine's domain name to locate America OnLine. America OnLine will then locate your PC on its internal database of nodes, and then allow the distant server to connect to your PC.

If you access a distant server via the Web, the distant server MUST know your IP address. Otherwise, it does not know where to send the files your PC requests. However, this doesn't mean the distant server automatically knows your identity.

A Web site might record 100 "visits" from America OnLine, but there is no way for the Web site to know whether this represents 100 different users or 100 visits from one individual. This is an example of what is known as a proxy server; individual PCs connect to the Internet through the proxy, and other servers connect to the individual PCs using the proxy server's domain name.

Hits, Visits, Impressions, and "Click-Through"

Because the Web is so new, some important terminology has yet to be standardized and may not mean what you think it does. Three that are widely misused are hits, visits, and impressions.

A lot of people think a hit is when someone visits your Web site. This is not correct. A hit simply is a request to download a file made by a distant computer. Since a Web page often has multiple files (text plus graphics), one person visiting a single page may produce multiple hits. One of the Web sites that I maintain has a home page with one text file and 12 graphics. When an individual visits that home page, 13 hits are generated.

This shows why hits are a very misleading indication of how much traffic a Web site is getting. (Despite this, several Web sites still feature "hit counters" on their home page.) A more meaningful measure is the visit, which is defined as any file requests made by a specific IP address in a continuous access of a server within a specified time period. The reason why a time period is specified is because some PCs, like those in libraries and businesses, are continuously connected to the Internet and may be left "parked" on a site used by multiple users. A visit more accurately measures what actually happens during a visit to a Web site by an individual.

Impressions are normally used to refer to how often an advertisement is displayed to visitors to a Web page. (Most Web ads are so-called banner ads of about 460x60 pixels.) For most Web pages, a visit to a page with an ad will yield one impression. However, some Web sites rotate different ads on a page, and the number of impressions for a given ad will be different than the number of visits to a page. Some servers will not record an impression if a visitor leaves a page before an ad graphic fully loads!

"Click-through" is a term indicating when an ad is clicked and the user then visits a page devoted to the advertiser, often located at the advertiser's Web site. Click-through is a measure of how effective an ad is; it means the ad was interesting enough to cause a visitor to want to learn more about the product or service being advertised. Click-through can be measured at the server hosting the Web page where the ad appeared, but can also be measured at the advertiser's Web page that the banner sends visitors to when clicked.

Other items about a Web site that you might want to record include how long a visitor spends on a certain page and any referring URL a visitor uses to access the site. A referring URL could be a search engine like Yahoo or another Web site that contains a link to your site. You can also determine which Web browsers visitors to your site use. This can be very useful in designing a site that the majority of

Session History for 199.120.124.26 (from/via Whem-Tv Channel 5)

Origin: Michigan, USA. Time: 14 min Hits: 21

Date and Time	URL
1997-11-26 08:14:28	Session Established
1997-11-26 08:14:28	/
1997-11-26 08:14:29	/dxing-com.gif
1997-11-26 08:14:30	/upfront.gif
1997-11-26 08:14:30	/radiofundamentals.gif
1997-11-26 08:14:30	/newhamradio.gif
1997-11-26 08:14:30	/scannermonitoring.gif
1997-11-26 08:14:31	/otherradioservices.gif
1997-11-26 08:14:31	/littledxing-com.gif
1997-11-26 08:14:31	/specialtylistening.gif
1997-11-26 08:14:31	/newswling.gif
1997-11-26 08:14:31	/otherradiolinks.gif

Figure 1

Identity	Visits Today	Percent of Total
Whem-Tv Channel 5 (MI,US)	5	5.38%
Uunet Technologies, Inc. (VA,US)	3	3.23%
America Online (VA,US)	3	3.23%
America Online (VA,US)	3	3.23%
Artemis Research (CA,US)	3	3.23%
America Online (VA,US)	2	2.15%
153.34.124.*	2	2.15%
At & T Its (FL,US)	2	2.15%
Managed Network Systems Inc. (ON,CA)	2	2.15%
Telecenter Hersbruck (DE)	2	2.15%
Goodnet (AZ,US)	1	1.08%
America Online (VA,US)	1	1.08%
156.46.121.*	1	1.08%
Provider Local Registry (PT)	1	1.08%

Figure 2

your visitors can easily view and also to determine when to add new features (like Dynamic HTML or channelized content) to your site.

Log Files

Data about visitors to a Web site is stored by the site's server in a log file. Visitors to a site and their activities are tracked by software installed on the server, and this software creates and updates the log file.

Log files are text files; in fact, most log file names end with the .TXT extension. Reading a "raw" log file can be time-consuming and burdensome, however, because of the large amount of information recorded in them. To get around this, several log file software packages will summarize and display recorded information in graphical form.

One popular graphical log file software package is called LiveStats. This is installed on a Windows NT server hosting a Web site I maintain, and I find it invaluable in learning about visitors to the site.

One great aspect of LiveStats is its ability to monitor the activity of current visitors to the site in "real time." Figure 1 shows the activity of a visitor from the domain assigned to WMEM-TV (see the IP address and domain name at the top following the "Session History for" tag). You can see when the visitor accesses the site, and each file (text, graphics, etc.) the visitor downloads in the visit. Keep in mind this feature of LiveStats is only functional for a visitor actually connected to the site. But it is a lot of fun to watch a "live" visitor navigate through the site!

Figure 2 shows a list of visitors for a single day to a site. If a domain name can be "resolved," it is listed by name in the list. If the name cannot be fully resolved, as much of the IP as possible (such as 153.34.124.* in Figure 2) will be shown. This sort of "partial resolution" usually indicates the visitor is accessing the site through a proxy server. Note that some domains, like America OnLine in Figure 2, are listed multiple times with multiple visits each time. This is because America OnLine, like other large ISPs, has multiple top-level domains that resolve to the same name; they have multiple domains to handle the volume of traffic they receive. Figure 2 shows a partial list of the domains from which visitors came to the site in a single day. Data can also be recorded for visitors in the previous 30- and 60-day periods.

Determining the most popular pages at a Web site is very important if you want to sell advertising or links, as the most popular pages can command higher ad rates. Figure 3 shows which pages have been visited the most on a single day. LiveStats also records this data for 30- and 60-day periods.

Even if your site is strictly non-commercial, it's valuable to know which pages are the most popular. If certain pages are heavily visited, that's a good sign that you should add more content to those pages or additional pages devoted to those topics. And if

Figure 3

URL	Hits Today	Percent of Hits
/ (default page)	61	22.68%
/newsroom.htm	22	8.18%
/scanfreq.htm	17	6.32%
/otherlinks.htm	15	5.58%
/runningu.htm	15	5.58%
/index.htm	14	5.20%
/loggings.htm	13	4.83%
/swbcweb.htm	9	3.35%
/swrx.htm	8	2.97%
/radioterms.htm	8	2.97%
/above30.htm	8	2.97%
/amband.htm	8	2.97%
/action.htm	7	2.60%

Figure 4

Referrer URL	Referral Today	Percent of Referrals
http://www.infoseek.com/titles?	11	23.91%
http://search.yahoo.com/search?	6	13.04%
http://www.dxing.com/	3	6.52%
http://users.abac.com/harryh/loggings...	2	4.35%
http://alpha.wcoil.com/~gnbc/	2	4.35%
http://www.dxing.com/otherlinks.htm	2	4.35%
http://altavista.digital.com/cgi-bin/q...	2	4.35%
http://www.search.hotbot.com/hresult.h...	2	4.35%
http://funnelweb.utcc.utk.edu/~jtdyhka...	1	2.17%
http://www.search.com/infoseek/1,135,0...	1	2.17%
http://www.yahoo.com/news_and_media/ra...	1	2.17%
http://www.wp.com/ed.ip/	1	2.17%

How A Cookie Crumbles

Probably no aspect of Web technology is more widely misunderstood than "cookies." According to some, cookies are insidious programs secretly downloaded to your PC via the Web that allow a Web site operator to view the entire contents of your hard drive or even erase files. According to others, cookies are harmless text files that have no effect whatsoever on your PC's operation.

So what's the real story?

The answer is that cookies really are harmless, if possibly annoying, text files that are usually (but not always) stored in the folder where your Web browser is found. Cookies don't allow someone to view or alter the contents of your hard drive; in fact, a cookie doesn't tell a Web site operator anything that he or she doesn't already know or that you don't voluntarily provide. And you can set almost all browsers to reject cookies or manually delete cookies you don't want.

Cookies were introduced with the release of Netscape 1.1. A cookie can be included with a Web page downloaded from a server. It is at this point that many "cookie opponents" trip over themselves due to their lack of understanding of technical issues. It is true that a cookie gets stored on your hard disk when you download a Web page, but so does the entire Web page. Web pages (including all graphics files) are temporarily "cached" on your hard drive; when you shut down your PC, the cached Web pages are lost. The only difference between a Web page and a cookie is that the cookie is permanently stored on your PC's hard drive instead of being cached.

Cookies are plain ASCII (.TXT) files. As such, they cannot do anything except be read by a program like a text editor. That's it! A cookie poses as much threat to your PC as a word processing document. A cookie cannot send information about other files on your PC back to a distant server. A server can view the cookie it downloaded to your PC, but no other files.

If they're so limited, why use them at all?

The most common use of a cookie is to assign a unique identification to each visitor to a Web site. This identifier is used by the server to track how often the user visits the site, which pages are visited, and how much time is spent on each page. When a visitor accesses a site, the server checks to see if a cookie with an identifier is present on the user's hard drive. If it is, the server uses it to track the activity of the visitor on the site. If no cookie is present, the server will download one containing an identifier.

Note that this unique identifier does not impinge on the visitor's privacy. The cookie does not let the server know the visitor's name, address, or telephone number ... the visitor's E-Mail address ... type of computer or Web browser ... in fact, the only thing the server knows about the user is the identifier. The term "identifier" is somewhat misleading, since it is more of a way to differentiate between users than it is a way to determine actual user identities.

The identifier in a cookie can be used with a database to determine visitor interests. Each time a visitor views a certain page, that data can be recorded in the database. This allows for precise targeting of information and ads that a visitor might be interested in. For example, a visitor might be greeted by a banner alerting him or her to new information or features elsewhere on the site that they will probably be interested in.

Another use of cookies is to store user passwords on sites that require passwords to access certain pages or on sites where user registration is required. When a user registers at a site or enters a password, the password is entered into a cookie and then downloaded to the user's PC. This means the user doesn't have to enter the password every time he or she accesses the site (and they don't have to remember it, either!).

Sophisticated Web sites use cookies to control how users are exposed to ads on a page. Each time a user views an ad on a page, the user identification contained in the cookie is recorded in a database along with the ad identification. The next time the user visits the page, the user identification in the cookie is used to identify ads the user has previously seen and sends new ads for the user to see.

Because of the alarm about cookies that appeared in the mainstream press, cookie "blocking" capability was introduced with Netscape 3.0 and Internet Explorer 3.0; it's been retained in all future releases of those two browsers. In addition to blocking, you can choose to have these browsers notify you each time a cookie is downloaded. You can also manually delete cookies from your hard drive; these are often stored in a folder labeled "Cookies" somewhere on your hard drive (this folder may be a subfolder within another folder, however).

Software Wizardry

Browser ID	Total Today	Percent of Total
mozilla/4.01 [en] (win95; i)	7	7.53%
mozilla/4.0 (compatible; msie 4.0; msn...	5	5.38%
mozilla/4.0 (compatible; msie 4.0; win...	5	5.38%
mozilla/3.0 (win16; i)	4	4.30%
mozilla/3.0 webtv/1.2 (compatible; msi...	3	3.23%
mozilla/3.01gold (win95; i)	3	3.23%
mozilla/2.0 (compatible; msie 3.0; win...	3	3.23%
mozilla/2.0 (compatible; msie 3.01; wi...	3	3.23%
mozilla/2.0 (compatible; msie 3.0; aol...	3	3.23%
mozilla/3.0 webtv/1.3 (compatible; msi...	3	3.23%
mozilla/4.03 [en] (win95; i)	2	2.15%
mozilla/3.01gold (winnt; i)	2	2.15%
mozilla/3.01 (win95; i)	2	2.15%

Figure 5

some pages are very lightly visited, you might consider devoting less effort to those pages or even dropping them altogether from the site.

Figure 4 shows part of the daily log of referring URLs. As you can see, most visitors who did not access the site directly were referred to it by Infoseek, a search engine, followed by Yahoo, another search engine. LiveStats also records this data for 30- and 60-day periods. This data is especially useful for discovering links to your site that you didn't even know existed! If you are paying for a link to your site (as through a banner ad on another Web site), this feature will let you know whether you're getting your money's worth.

Finally, LiveStats lets you see which browsers visitors are using. Figure 5 shows a partial list of a daily log; 30- and 60-days records are also maintained. The exact terminology used to describe browsers varies with the logging software used but, in this case, I know that most visitors used Netscape 4.01, followed by two versions of Internet Explorer 4.0, and the 16-bit version of Internet Explorer 3.0. You can also see that some visitors used the WebTV browser and Netscape's Navigator Gold.

The data in Figure 5 indicates that most visitors to the site use browsers that support JavaScript and Java applets, so I can use these on the site with confidence that most users will be able to take advantage of them. However, most visitors do not use browsers that support some form of channels (like the Active Channel technology included in Internet Explorer 4.0). Thus, I need to make sure that any channelization features that I add are compatible with the browsers that most visitors use.

I want to again emphasize that there are many other server logging software packages other than LiveStats. Each has its own advantages and disadvantages, and no one package will be best for each Web site. However, most will record and display the data we discussed in this section in a similar form

Getting More Data

Log files tell you very little about individual visitors to a Web site. If you're trying to sell advertising on your Web site, or want to sell products and services to visitors, you need to know things like their age, sex, income, education, etc.

The most common way to get this information is to register site visitors. Registration can be either compulsory or voluntary, and data indicates that response is actually higher for voluntary registration unless a site has compelling, "brand name" content (like the New York Times Web site). Another approach is to require registration for access to certain sections of a site, like chat rooms and message boards.

Data about a visitor to a Web site can be stored in the form of a text file known as a cookie and stored on a visitor's hard drive. Cookies are the subject of a lot of misinformation and misunderstanding, as discussed in the accompanying sidebar.

As someone who has spent most of his life working in print, I'm really excited about the Web's ability to let me better understand the preferences and interests of site visitors. If my visitors like something, I know to give them more; if my visitors don't like something, I know to try something new! NV

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TEK DA4084 Programmable Distortion Analyzer $1,000.00

RMS VOLTMETERS

FLUKE 8920A True RMS Voltmeter, ... $600.00
180 uV-700 V, 10 Hz-20 MHz
FLUKE 8922A True RMS Voltmeter, ... $600.00
180 uV-700 V, 2 Hz-11 MHz

OSCILLATORS

HP 204C Oscillator, 5 Hz-1.2 MHz, 5 VRMS $150.00
HP 204D Oscillator, 5 Hz-1.2 MHz, 5 VRMS, ... $200.00
80 dB step attenuator
HP 209A Sine/Square Wave Generator, ... $225.00
4 Hz-2 MHz, 5 VRMS max.
HP 652A Test Oscillator, 10 Hz-10 MHz $250.00
TEK SG502 Sine/Square Osc., 5 Hz-500 kHz, ... $200.00
70 dB step atten.,TM500

MISCELLANEOUS

HP 4437A Step Attenuator, 0-119.9 dB, ... $175.00
DC-1 MHz, 600 ohms unbal.
HP 461A Amplifier, 20/40 dB, ... $125.00
1 kHz-150 MHz, 0.5 V/50 Ohms
KROHN-HITE 3103 High/Low Pass Filter, ... $500.00
10 Hz-3 MHz, 24 dB/octave
KROHN-HITE 3342R Dual HP/LP Filter, ... $1,100.00
0.001 Hz-99.9 kHz, 48 dB/octave
KROHN-HITE 3750 LP/HP/BP/BR Filter, ... $700.00
0.02 Hz-20 kHz, 6/12/18/24 dB/oct.
ROCKLAND 852 Dual Highpass/Lowpass $1,000.00
Filter, 0.1 Hz-111 kHz
TEK AF501 Tunable Bandpass Filter / $300.00
Amplifier, 3 Hz-35 kHz
TEK AM502 Differential Amplifier, ... $475.00
0.1 Hz-1 MHz, TM500 series

RF & MICROWAVE

SPECTRUM ANALYZERS

HP 11970A WR28 Harmonic Mixer, 26.5-40 GHz $1,100.00
HP 11970Q WR22 Harmonic Mixer, 33-50 GHz $1,400.00
HP 11971A WR28 Harmonic Mixer, ... $1,100.00
26.5-40.0 GHz, for 8569B
HP 11971K WR42 Harmonic Mixer, ... $1,100.00
18.0-26.5 GHz, for 8569B
HP 8406A Comb Generator, ... $450.00
1/10/100 MHz increments, to 5 GHz
HP 8444A-059 Tracking Generator, ... $1,250.00
0.5-1500 MHz, for 8554,8568,etc.
HP 8445B Preselector, 1.8-18.0 GHz, for HP 8555A $650.00
HP 8553B/8552B/8443/141 Spectrum $2,500.00
Analyzer, 0.1-110 MHz, with tracking generator
HP 8557A/182T Spectrum Analyzer, ... $1,500.00
0.01-350 MHz, 1 kHz min. res.
HP 8565A-100 Spectrum Analyzer, ... $5,000.00
10 MHz-22 GHz, 100 Hz min.res.bw.
HP 8569B Spectrum Analyzer, ... $8,500.00
10 MHz-22 GHz, 100 Hz min.res.bw.
TEK 119-0098-00 WR42 Single $200.00
Ended Mixer, 18.0-26.5 GHz, for Tek 491
TEK 119-0099-00 WR28 Single $200.00
Ended Mixer, 26.5-40 GHz, for Tek 491
TEK TR503 Tracking Generator, 0.1-1800 MHz, for 492/4/5/6 ..... $1,375.00
TEK WM490A WR28 Harmonic Mixer, 26.5-40 GHz $850.00
TEK WM490K WR42 Harmonic Mixer, 18.0-26.5 GHz $850.00
TEK WM782V WR15 Harmonic Mixer, 50-75 GHz $2,000.00

NETWORK ANALYZERS

HP 11665B Modulator, 0.15-18.0 GHz, N(m/f) $325.00
HP 11666A Reflectometer Bridge, ... $1,100.00
0.04-18.0 GHz, for HP 8755/6/7

SIGNAL GENERATORS

FLUKE 6060A Synthesized Signal Gen., ... $2,750.00
0.1-1050 MHz, 10 Hz res., GPIB
FLUKE 6060A/AN Synthesized Signal Gen., ... $2,000.00
10 kHz-520 MHz, 10 Hz res,GPIB
FLUKE 6062A Signal Generator, ... $5,500.00
0.1-2100 MHz, 10 Hz resolution
FLUKE 6070A Synthesized Signal $2,000.00
Generator, 0.2-520 MHz, 1 Hz res.
GIGATRONICS 600/10-18 Synthesized $2,600.00
Source, 10-18 GHz, 1 MHz res., GPIB
GIGATRONICS 605/10-18 Synthesized $3,000.00
Source, 10-18 GHz, 1 kHz res., GPIB
GIGATRONICS 605/2-8 Synthesized $3,000.00
Signal Gen., 2-8 GHz, 1 kHz res., GPIB
GIGATRONICS 840-01 Freq. Doubler, ... $2,000.00
26.5-40 GHz (WR28) out, 13-20 GHz in
GIGATRONICS 875/50 Levelled Multiplier, ... $3,500.00
x4, 50.0-75.0 GHz output, -3 dBm
GIGATRONICS 875/86 Levelled Multiplier, ... $5,000.00
26.5-40.0 & 50.0-75.0 GHz outputs
GIGATRONICS 910/12-18,opt6,14,16 ..... $3,500.00
Synthesized Source/Sweeper, 12-18 GHz, 1 Hz res., OCXO
HP 11720A Pulse Modulator, 2-18 GHz, 80 dB on/off ratio $750.00
HP 85100V Frequency Mult., ... $4,250.00
10-15 GHz in / 50-75 GHz out >0 dBm
HP 8640B-001,002 Signal Gen., ... $2,200.00
0.5-1024 MHz, AM, FM, var. audio osc.
HP 8654A Signal Generator, ... $550.00
10-520 MHz, calibrated AM & uncal. FM
HP 8660C/86602B-002 Synth. Sig. Gen., ... $3,250.00
1-2600 MHz, FM / Phase mod. w/86635A

SWEEP GENERATORS

HP 8600A Digital Marker, for HP 8601A $400.00
HP 8601A Generator/Sweeper, 0.1-110 MHz, +20 dBm levelled $400.00
HP 8620C Sweep Oscillator Frame $550.00
HP 8620C-011 Sweep Oscillator Frame, HPIB programmable $675.00
HP 86222A-002 RF Plug-in, ... $1,600.00
10-2400 MHz, +13 dBm levelled, 70 dB atten.
HP 86230B RF Plug-in, 1.8-4.2 GHz, +10 dBm unlevelled $675.00
HP 86235A-001,002 RF Plug-in, ... $1,000.00
1.7-4.3 GHz, +14 dBm levelled, 70 dB atten.
HP 86240C RF Plug-in, 3.6-8.6 GHz, +16 dBm levelled $1,000.00
HP 86241A-001 RF Plug-in, 3.2-6.5 GHz, +8 dBm levelled $500.00
HP 86242D-004,008 RF Plug-In, ... $500.00
5.9-9.0 GHz, +10 dBm levelled
HP 86245A RF Plug-in, 5.9-12.4 GHz, +16 dBm levelled $1,100.00
HP 86250D RF Plug-in, 8.0-12.4 GHz, +10 dBm levelled $675.00
HP 86260A RF Plug-in, 12.0-18.0 GHz, +10 dBm unlevelled $800.00
HP 86260A-H04 RF Plug-in, ... $800.00
10.0-15.0 GHz, +10 dBm unlevelled
HP 86290A RF Plug-in, 2.0-18.0 GHz, +7 dBm levelled $1,750.00
HP 86290B RF Plug-in, 2.0-18.6 GHz, +10 dBm levelled $2,000.00
WAVETEK 962 Sweep Generator, ... $1,500.00
1.0-4.0 GHz, markers, +12 dBm unlvld.
WILTRON 560/ 3x 560-7S50 Scalar $1,750.00
Network Analyzer, w/(3) 0.01-18.5 GHz detectors

POWER METERS

ANRITSU MP-81B/ML-83A Power Meter, ... $2,500.00
75-110 GHz (WR10), -20 to +20 dBm
ANRITSU MP-82B/ML-83A Power $3,250.00
Meter, 90-140 GHz (WR8) pin flange, -20, +20 dBm
BOONTON 4200-01A,03/&-4A x2 Dual $1,500.00
Channel Microwattmeter, w/(2) 1 MHz-7 GHz sensors
BOONTON 42B/41-4B Analog $375.00
Power Meter, with 1 MHz-12 GHz sensor
BOONTON 42B/41-4E Analog Power Meter, ... $500.00
with 1 MHz-18 GHz sensor
GENERAL MICROWAVE 476/4240A $300.00
Power Meter & Sensor, 0.01-18 GHz, -35 to +10 dBm
HP 432A/8478B Power Meter, ... $450.00
-25 to +10 dBm, 10 MHz-18 GHz
HP 435A/8481A Power Meter, ... $900.00
10 MHz-18 GHz, -30 to +20 dBm
HP 435A/8482H Power Meter, ... $950.00
0.1-4200 MHz, -10 to +34 dBm
HP 8477A Power Meter Calibrator, for HP 432 series $500.00
HP Q8486A Power Sensor, ... $1,500.00
33.0-50.0 GHz, WR22, for 435/6/7/8
HP R486A WR28 Thermistor Mount, 26.5-40 GHz, for 432 series $350.00

RF MILLIVOLTMETERS

BOONTON 9200A-01 RF Millivoltmeter, 10 kHz-1.2 GHz, GPIB $900.00
RACAL 9303 TRMS Level Meter, ... $875.00
10 kHz-2 GHz, -77 to +23 dBm, GPIB

AMPLIFIERS, MISCELLANEOUS

BOONTON 82AD-opt.01A Modulation Meter, ... $900.00
AM, FM, 10-1200 MHz, GPIB
HP 465A Amplifier, 20/40 dB, 5 Hz-1 MHz, 1/2 Watt/50 Ohms $125.00
HP 8447A-001 Dual Amplifier, 0.1-400 MHz $450.00
HP 8447E Amplifier, 22 dB, 0.1-1300 MHz, +13 dBm output $750.00
HP 8901A Modulation Analyzer, 150 kHz-1300 MHz $3,750.00
HP 8901B-001 Modulation Analyzer, ... $6,750.00
150 kHz-1300 MHz, rear panel input
HP 8970A Noise Figure Meter $6,000.00
HUGHES 1177H01F000 TWT Amplifier, ... $1,500.00
2.0-4.0 GHz, 10 Watts output
HUGHES 1177H02F000 TWT Amplifier, ... $1,500.00
4.0-8.0 GHz, 10 Watts output
HUGHES 1277H02F000 TWT Amplifier, ... $2,500.00
4.0-8.0 GHz, 20 Watts output
HUGHES 8020H02F000 TWT Amplifier, ... $2,750.00
4.0-8.0 GHz, 20 Watts output
M.P.D. LAB2-1020-2A Amplifier, 34 dB, 1.0-2.0 GHz, 2 Watts $800.00
M.P.D. LAB2-714-3A Amplifier, 34 dB, 0.7-1.4 GHz, 3 Watts $800.00
MICROWAVE SEMI.CORP. MC5112 Noise $275.00
Source, 25.5 dB ENR, 1.0-12.4 GHz, N(m), +28 VDC
ROHDE & SCHWARTZ ESH2 Test Receiver, 9 kHz-30 MHz $6,000.00

COAXIAL & WAVEGUIDE

AMERICAN NUCLEONICS AM-432 Cavity $95.00
Backed Spiral Antenna,LHC, 2-18 GHz,TNC(f) *NEW*
ELECTRO IMPULSE TX-100-3 3 dB Attenuator, ... $135.00
100 Watts, DC-1 GHz, N(f/f)
FXR/MICROLAB S3-02N Triple Stub Tuner, ... $125.00
200-1000 MHz, 100 Watts max., N(m/f)
GR 874-LTL Constant Impedance $400.00
Trombone Line, 0-44 cm, DC-2 GHz
GR 900-Q GR900 14mm Interseries Adapters $125.00
HP 11590A-001 Bias Network, 1.0-18.0 GHz, APC7 ..... $450.00
HP 11612A Bias Network, 45 MHz-26.5 GHz, APC3.5 ..... $550.00
HP 11691D Directional Coupler, 22 dB, 2-18 GHz $450.00
HP 11692D Dual Directional Coupler, 22 dB, 2-18 GHz $800.00
HP 11904B APC2.4(f) x K(f) Adapter, DC-40 GHz $225.00
HP 774D Dual Directional Coupler, 20 dB, 215-450 MHz $275.00
HP 777D Dual Directional Coupler, 20 dB, 1.9-4.1 GHz $275.00
HP 778D-011 Dual Dir. Coupler, ... $450.00
20 dB, 0.1-2.0 GHz, APC7/N(f/f/f)
HP 8470B Crystal Detector, 10 MHz-18 GHz, neg. pol., APC7 ..... $250.00
HP 8491A-030 30 dB Attenuator, DC-12.4 GHz, 2 Watts, N(m/f) $50.00
HP 8494G-002 Programmable Step $400.00
Attenuator, 0-11 dB, DC-4 GHz, SMA
HP 8495G-002 Programmable Step $300.00
Attenuator, 0-70 dB, DC-4 GHz, SMA
HP 8495H-002 Programmable Step $400.00
Attenuator, 0-70 dB, DC-18 GHz, SMA
HP 8497K-004 Programmable Step $750.00
Attenuator, 0-90 dB, DC-26.5 GHz
HP K422A WR42 Flat Broadband Detector, 18.0-26.5 GHz $350.00
HP K532A WR42 Frequency Meter, 18.0-26.5 GHz $450.00
HP K870A WR42 Slide Screw Tuner, 18.0-26.5 GHz $275.00
HP K914B WR42 Moving Load, 18.0-26.5 GHz $350.00
HP Q752D WR22 Directional Coupler, 20 dB, 33-50 GHz $650.00
HP R375A WR28 Variable Attenuator, 0-20 dB, 26.5-40 GHz $375.00
HP R422A WR28 Flat Broadband Detector, 26.5-40 GHz $400.00
HP R532A WR28 Frequency Meter, 26.5-40 GHz $500.00
HP R752A WR28 Directional Coupler, 3 dB, 26.5-40 GHz $450.00
HP R914B WR28 Moving Load, 26.5-40 GHz $300.00
HP V365A WR15 Isolator, 25 dB, 50-75 GHz $900.00
HP V752D WR15 Directional Coupler, 20 dB, 50-75 GHz $650.00
HP X870A WR90 Slide Screw Tuner $150.00
HUGHES 45111H-2000 WR28 Isolator, 25 dB, 26.5-40 GHz $450.00
HUGHES 45712H-1000 WR22 Frequency Meter, 33-50 GHz $900.00
HUGHES 47316H-1111 WR10 Tuneable $750.00
Detector, 75-110 GHz, positive polarity
HUGHES 47323H-1211 WR19 Flat $650.00
Broadband Detector, negative, 40-60 GHz
HUGHES 47974H-1000 WR15 SPST $375.00
PIN Switch, 250 MHz speed, 60-62 GHz response
INSULATED WIRE SPRR-175-78 Low $45.00
Loss Coaxial Cable, 78 in., DC-18 GHz, SMA(m/ram)
KAY 442D Step Attenuator, 0-101 dB, 75 ohms, BNC $100.00
KRYTAR 1818 Directional Coupler, 16 dB, 2-18 GHz, SMA(f) $200.00
M/A-COM 3-19-300/10 WR19 ..... $450.00
Directional Coupler, 10 dB, 40-60 GHz
MIDWEST MICROWAVE 3537 DC Block, ... $40.00
0.1-12.4 GHz, SMA(m/f) *NEW*
MINI-CIRCUITS ZFDC-20-4 Directional $25.00
Coupler, 19.5 dB, 1-1000 MHz, SMA(f)
NARDA 25171 Level Set Attenuator, 0-17 dB, 2-8 GHz, SMA(f) $100.00
NARDA 26298 20 dB Attenuator, 150 Watts, DC-1 GHz, N(f/f) $200.00
NARDA 3000-SERIES Directional Couplers $150.00
NARDA 3024 Bi-Directional Coupler, 20 dB, 4-8 GHz $300.00
NARDA 3090-SERIES Precision High Directivity Couplers $225.00
NARDA 368NM Coaxial High Power Load, ... $400.00
500 Watts, 2.0-12.4 GHz, N(m)
NARDA 369BNF High Power Termination, ... $325.00
175 Watts, 0.7-18 GHz, N(f)
NARDA 3753B Coaxial Phase Shifter, ... $1,250.00
0-55 deg./GHz, 3.5-12.4 GHz
NARDA 4000-SERIES SMA Miniature Directional Couplers $75.00
NARDA 4203-6 Directional Coupler, 6 dB, 2-18 GHz, SMA(f/f/f) $225.00
NARDA 4245-10 Directional Coupler, 10 dB, 4-12 GHz, SMA(f) $100.00
NARDA 4799 Level Set Attenuator, 0-15 dB, 4-18 GHz, SMA(f) $135.00
NARDA 5070-SERIES Precision Reflectometer Couplers $300.00
NARDA 765-20 20 dB Attenuator, 50 Watts, DC-5 GHz, N(m/f) $135.00
NARDA 766-10 10 dB Attenuator, 20 Watts, DC-4 GHz, N(m/f) $100.00
NARDA 768-20 20 dB Attenuator, 20 Watts, DC-11 GHz, N(m/f) $125.00
NARDA 792FF Variable Attenuator, 0-20 dB, 2.0-12.4 GHz $375.00
NARDA 794FM Direct Reading Variable $375.00
Attenuator, 0-40 dB, 4-8 GHz
OMNI-SPECTRA 2085-6010-00 Crystal $50.00
Detector, 1-18 GHz, negative polarity, SMA(m/f)
PAMTECH KYG1014 WR42 Junction Circulator, 18.0-26.5 GHz $250.00
SONOMA ENG. S-4901 WR15 Junction Isolator, ... $125.00
57-59 GHz, 30 dB isolation
SONOMA ENG. S-4906 WR15 Junction Isolator, ... $125.00
60-62 GHz, 30 dB isolation
SONOMA ENG. S-4907 WR15 Junction Isolator, ... $125.00
62-64 GHz, 30 dB isolation
SONOMA SCIENTIFIC 21A3 WR42 ..... $125.00
Circulator, 20 dB, 20.6-24.8 GHz
SPACEK LABS DQ-1 WR22 Flat $400.00
Broadband Detector, 33-50 GHz
TRG B528 WR22 Direct Reading Phase $1,250.00
Shifter, 0-360 deg.,33-50 GHz
TRG V551 WR15 Frequency Meter, 50-75 GHz $600.00
TRG W551 WR10 Frequency Meter, 75-110 GHz $750.00
WAVELINE 100080 WR28 Terminated $250.00
Crossguide Coupler, 30 dB
WEINSCHEL 1515 Power Divider, 2-Way, ... $125.00
DC-18 GHz, SMA(m/f/f)
WILTRON 4612K Programmable Step $800.00
Attenuator, 0-70 dB, DC-40 GHz

LOGIC

HP 10343B/10269C SCSI Bus Preprocessor, ... $300.00
w/probe intfc., for 1630 series
HP 5005A Signature Multimeter $350.00
HP 8170A-002 Logic Pattern Generator, ... $1,200.00
2 MB/s, address driver option
TEK 1240D2/1D 10-channel 50 MHz D/A $50.00
Module for 1240, without probes
TEK 30DM08 80286 Probe, for Tek Prism $50.00
TEK DP186P 80186 / 80188 Probe, for Tek 1230 ..... $50.00
TEK DP286P 80286 Probe, for Tek 1230 ..... $50.00
TEK DPHC11 68HC11 Probe, for Tek 1230 ..... $50.00
TEK P6454 100 MHz Clock Probe, for DAS $50.00

COMMUNICATIONS

HP 4972A LAN Protocol Analyzer $1,500.00
HP 59401A HPIB Bus Analyzer $700.00
TEK 1410R NTSC Gen., w/SPG2 sync. $1,000.00
generator, TSG7 color bars
TEK 1411R PAL Gen.,w/SPG12 sync; $1,000.00
TSG11 color bars;TSG13 linearity
TEK 1411R PAL Test Gen., ... $1,400.00
w/SPG12,TSG11,TSG13,TSG15,TSG16
TEK 1411R PAL Test Gen., ... $1,600.00
w/SPG12,TSG11,TSG12,TSG13,TSG15,TSG16
TEK 1411R-opt.04 PAL Test Gen., ... $1,900.00
w/SPG12,TSG11,TSP11,TSG13,TSG15,TSG16
TEK 147A NTSC Test Signal $800.00
Generator, with noise test signal
TEK 148 PAL Insertion Test Signal Generator $800.00
TEK 1750 NTSC Waveform / Vector Monitor $2,750.00
TEK 520A NTSC Vectorscope $750.00
TEK 521A PAL Vectorscope $750.00

MISCELLANEOUS

P.A.R. 5206-97 Two-Phase Lock-in Amp., 2 Hz-200 kHz $1,500.00
TEK TM5006 5000-series 6-slot $600.00
Programmable Power Module
TEK TM504 500-series 4-slot Power Module $175.00
TEK TM506 500-series 6-slot Power Module $250.00
TEK TM515 500-series 5-slot Traveller Power Module $275.00

90 DAY WARRANTY & 10 DAY INSPECTION
WE BUY AND SELL

HEWLETT PACKARD

10833A/B/C, HPIB Cables, 1/2/4 meter ..... 3 for $50
11730D, Power Sensor Cable, 50 Ft (new) $75
16095A, Probe Fixture (used on 4192A) $175
1740A, 100 MHz Scope $375
1741A, 100 MHz Storage Scope $400
180TR, Rack Mount Display $200
214B, 10 MHz Pulse Generator, 100V/50 ohms $1400
3310A, 5 MHz Function Generator $200
3310B, 5 MHz Function Generator $225
3311A, Function Generator, .01 Hz-1 MHz $175
3312A, Function Generator, 0.1 Hz-13 MHz $650
332A, Distortion Analyzer $150
3400A, RMS Voltmeter, 10Hz-10MHz $175
3403C, Digital RMS Voltmeter, 2 Hz-100 MHz $325
3421A-201/44462A, Data Aquisition Control Unit, HPIB ... $375
3455A, 6.5 Digit Multimeter, HPIB $350
3456A, 6.5 Digit Multimeter, HPIB $700
3465A, 4.5 Digit Multimeter $175
3478A, 5.5 Digit Multimeter, HPIB $600
3497A, Data Acq/Cont Unit $200
355C, Step Attenuator, DC-1 GHz, 1 dB steps $175
3575A, Gain/Phase Meter, 1 Hz-13 MHz $700
4328A-01, Milliohmmeter w/ battery opt $1100
432A/478A, Power Meter, 10 MHz-10 GHz $225
432A/8478B, Power Meter, 10 MHz-18 GHz $325
435A, Power Meter $200
436A, Power Meter $1100
4437A, Step Attenuator, DC-1 GHz, 600 ohm $175
44711A, 24 Chan FET Multiplexer $200
467A, Power Amp./Supply, DC-1 MHz, 10 Watt peak $150
491C, Amplifier, 2 GHz-4GHz, 1 Watt, 30dB Gain $675
4954A, Protocol Analyzer $1700
5300A w/5302A, 50 MHz Counter $100
5300A w/5303A, 500 MHz Counter $200
5314A, 100 MHz Counter $175
5316A, 100 MHz Counter, HPIB $450
5328A, 100 MHz Counter $175
5328A-021-030, 512 MHz Counter w/DVM $400
5334A, 100 MHz Counter, HPIB $650
5334B, 100 MHz Counter, HPIB $800
5335A-040, 200 MHz Counter, HPIB $700
5335A-010-040, 200 MHz Counter, Oven Osc, HPIB $900
536A, Frequency Meter, 0.96-4.2 GHz $100
5370B, Time Int Counter, 100 MHz, 100 pS accuracy $2250
5508A, Measurement Display (for 5528A Laser Meas Sys) $900
59306A, Relay Actuator $125
59313A, A/D Converter $100
59501B, Isolated DAC/Power Supply Programmer $125
6002A-01, Pwr Sup, 200 W, 0-50V@ 0-10A, GPIB $675
6034L, Dig Autoranging Pwr Sup, 60V/10A/200W, HPIB ... $850
6110A, (Har), Pwr Sup, 0-3KV@6mA (cables incl) $300
6112A, Precision Pwr. Sup., 0-40V@0.5A $275
6130C-J99, Prog Voltage Source, +/- 50V, +/- 1A $350
6181B, Constant Current Source, 100V, 250 mA $300
6200B, Pwr. Sup., 0-40V@0.75A or 0-20V@1.5A $200
6201B, Pwr. Sup., 0-20V@1.5A $150
6214C, Pwr. Sup., 0-10V@1A $100
6227B, Dual Pwr Sup, 0-25V@2A $475
6253A, Dual Pwr. Sup., 0-20V@3A $400
6261B-026, Pwr Sup, 0-20V @50A $575
6267B, Pwr Sup, 0-40V @10A $475
6268B, Pwr Sup, 0-40V @ 30A $750
6271B, Pwr Sup, 0-60V@3A $350
6284A, Pwr Sup, 0-20V@3A $225
6289A, Pwr Sup, 0-40V@1.5A $225
6294A, Pwr Sup, 0-60V@1A $225
6384A, (Har), Pwr. Sup., 4-5.5V@8A $75
6434B, Pwr Sup, 0-40V@25A $650
6515A, (Har), Pwr Sup, 0-1.6KV@5mA (cables incl) $275
6516A, High Voltage Pwr Sup, 0-3KV @ 5mA $375
6824A, Pwr. Sup./Amplifier, +/- 50V, +/-1A, 20 dB gain, DC-10 KHz $275
6827A, Pwr Sup/Amplifier, +/-100V, +/-0.5A, 80dB gain, DC-15 KHz $500
7595B, DraftMaster SX Plotter, sizes A through E $1750
8007B, Pulse Generator, 100 MHz $450
8011A, Pulse Generator, 20 MHz $125
8084A, Word Generator Plug-In, 300 MHz $275
8406A, Comb Generator, 1/10/100 MHz to 5 GHz $400
8444A-059, Tracking Generator, 0.5-1500 MHz $600
8445B-2-3, Tracking Preselector, 1.8-18 GHz $400
853A/8558B, Spectrum Analyzer, 0.1-1500 MHz $3500
8620C-011, Sweep Oscillator Mainframe, GPIB $400
86250D, RF Plug-In, 8.0-12.4 GHz $375
86290B, RF Plug-In, 2.0-18.6 GHz $1400
8640B, Signal Generator, 0.5-512 MHz $1200
86602B, RF Plug-In, 1-1300 MHz $600
8660C/86631B/86602A, Synth Sig Gen, 1.3 GHz, HPIB ... $1800
9411B, Automatic Test Station Switch Cont, HPIB $750
R382A, Precision Variable Attenuator, 26.5-40.0 GHz $1500
X486A, Thermistor Mount, 8.0-12.4 GHz $50
X752D, Directional Coupler, 20dB, 8.0-12.4 GHz $50

TEKTRONIX

2337, 100 MHz O'Scope $850
465, 100 MHz Dual Trace Oscilloscope $425
475, 200 MHz Dual Trace Oscilloscope $650
577D1/177, Storage Curve Tracer w/ std test fixture $1700
7104, 1 GHz O'Scope Mainframe $1700
7603, 100 MHz O'Scope w/ 7A26, 7B53A $300
7844, 400 MHz Dual Beam Oscilloscope, w/ 7A24, 7A26, 7B80, 7B85 ..... $900
7A13, 105 MHz Differential Comparitor $150
7A18, 75 MHz Dual Trace Amplifier $50
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GenRad 219M, Decade Capacitor, 1.11 uF $75
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JC Systems 520, Temperature Setpoint Programmer $200
Keithley 169, 3.5 Digit Multimeter, battery operated $75
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Lambda LQ-532, Pwr. Sup., 0-40V@5A, Dig Display $175
Laser Precision TD-9920, OTDR w/ case & manual $575
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Narda 4203-16, Directional Coupler, 2-18 GHz (SMA) $100
Narda 8616, RF Radiation Monitor w/probes $600
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Phoenix 5500-624-1, T1 Interface Plug-in $350
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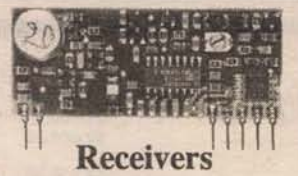

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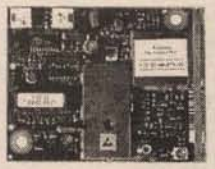

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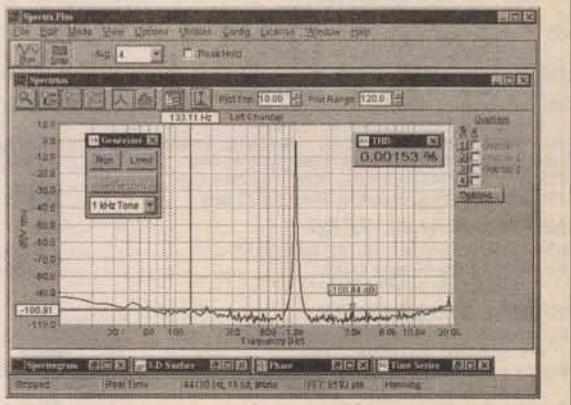

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THE WEEKEND WORKBENCH

featuring Andy A. Node

In this column, ANDY A. NODE describes fun projects that you can put together in an evening or two using off-the-shelf parts that are readily available from Radio Shack, Digi-Key, and most electronic retailers and mail-order houses.

Welcome to the Weekend Workbench. My name is Andy A. Node and I will be your host. Each month, I will showcase a unique or stimulating project lifted from my very own workbench, such as a wireless microphone, lie detector, foxhole radio, and much more.

Each project will include a detailed parts list that itemizes catalog numbers for both Radio Shack and Digi-Key, and a printed circuit board pattern and layout whenever possible.

Realizing that not every reader is equipped to make a printed circuit board, I've made special arrangements with a vendor from whom you can purchase an etched and drilled circuit board.

I hope you enjoy the column, and look forward to your comments and suggestions.

Kicking off our new series of one-night projects is a gadget all of us have wanted at one time or another — an on/off touch switch. Unlike most touch switches — which have one touch plate for ON and another for OFF — this switch has but a single touch plate. Touch it once, and it's on; touch it again, and it's off. Now wouldn't that be useful installed in your bed lamp? Smack it once and the light is on; smack it again, and it's lights off (shades of the Clapper, but better).

The solid-state relay interface described in this article can control any 115VAC resistive load up to 300 watts. Moreover, the circuit can be battery-operated, so it's not tied to the AC power line like so many touch switches of its kind. It can switch any type of load you want anywhere you want, using a simple relay modification, which we will describe. So without further ado, let's get started.

This Month: Touch Switch

Touchy Subject

Whether you realize it or not, you encounter touch switches everyday. You use them to summon an elevator, withdraw cash from an ATM, and pump gas into your car. Unlike conventional mechanical switches, touch switches require no physical force to activate them. You simply touch a sensor pad and the switch responds.

In most cases, the switch is of the momentary kind, where the switch closes when you touch it and opens when you remove your finger. This is fine for ATM tellers, but not desirable for on/off applications, such as a light switch. Our touch switch doesn't have this limitation. Touch it once, and the light goes on and stays on. Touch it a second time, and the light turns off. On, off, on, off ... with each touch of the finger.

Construction

The touch switch is a simple cir-

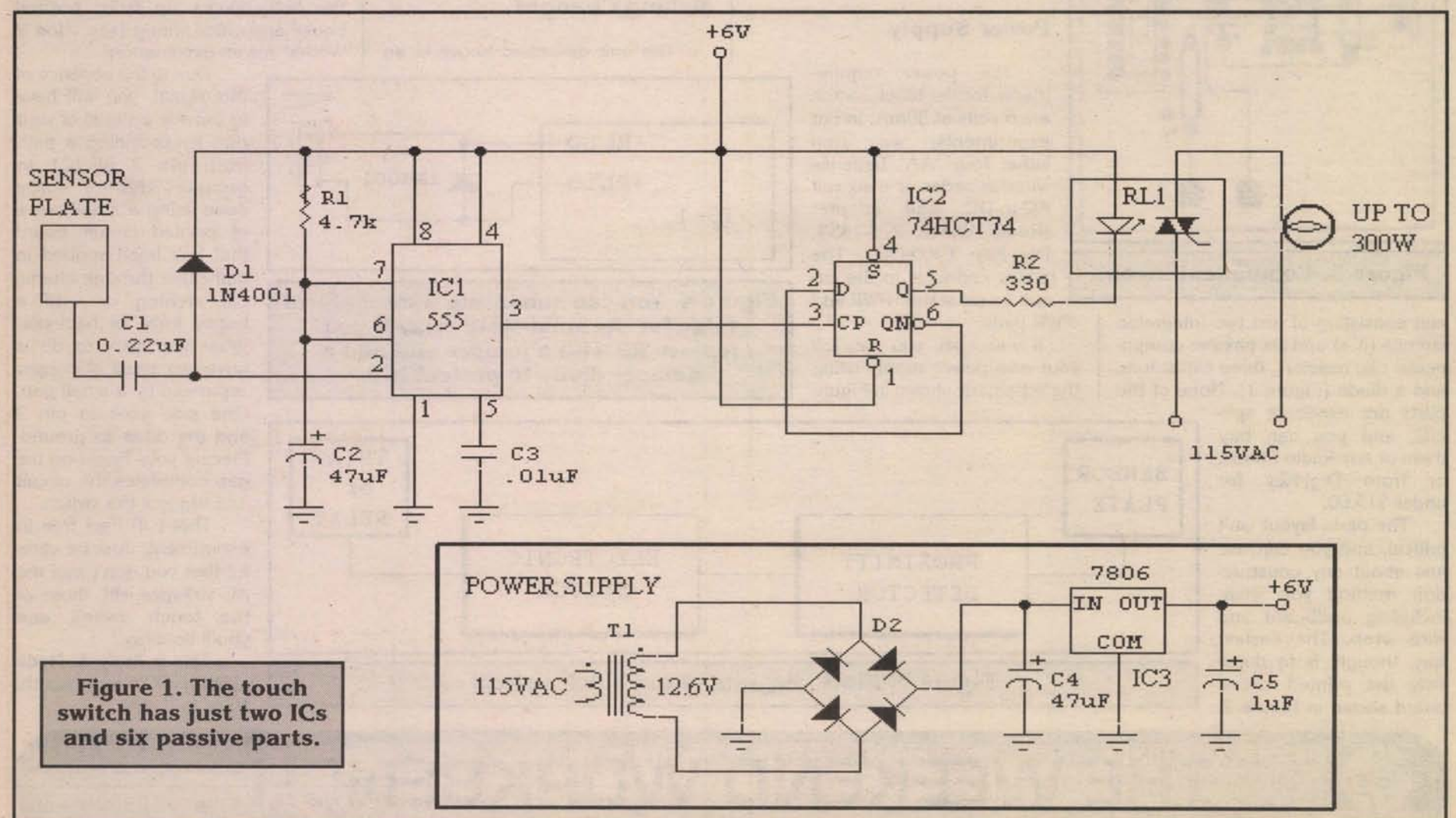

Figure 1. The touch switch has just two ICs and six passive parts.

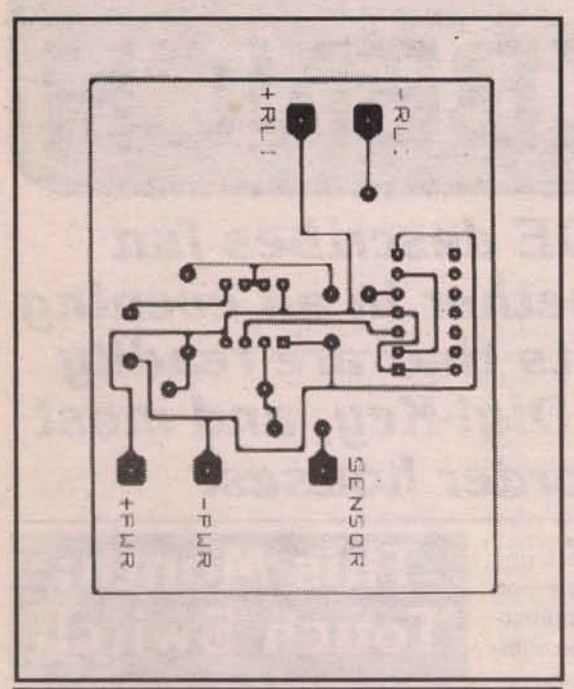

Figure 2. Actual-size foil pattern of the touch switch.

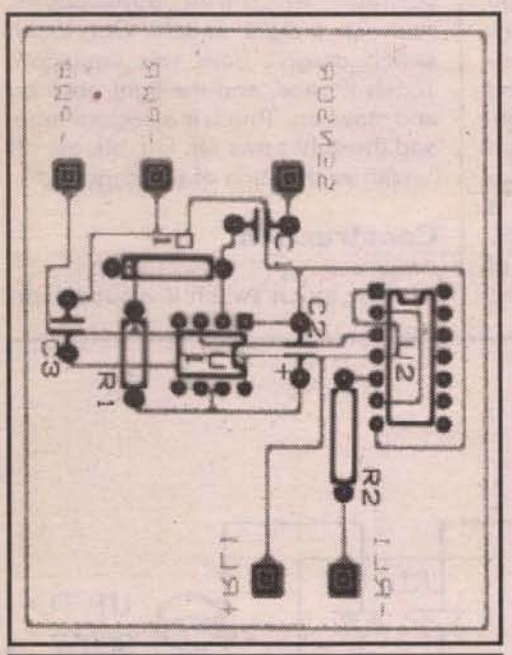

Figure 3. Component layout.

cuit consisting of just two integrated circuits (ICs) and six passive components: two resistors, three capacitors, and a diode (Figure 1). None of the parts are exotic or special, and you can buy them at any Radio Shack, or from Digi-Key for under $15.00.

The parts layout isn't critical, and you can use just about any construction method you wish, including perfboard and wire wrap. The easiest way, though, is to duplicate the printed circuit board shown in Figure 2. Simply mount the components as shown in Figure 3, and solder them in place using a small-wattage (20W) soldering iron and rosin-core solder (don't use acid-core solder!).

You'll notice that the relay, RL1, isn't mounted on the circuit board. This is done on purpose. You don't want to mix high voltages and low voltages if you can avoid it. We can. Notice that there are two solder pads on the circuit board labeled +RL1 and -RL1. These go to the "coil" of the solid-state relay using regular hookup wire. The AC side of the relay can be used just like a wall switch for controlling the load.

The sensor plate is a small square of metal, about one inch across, that connects to the circuit board at the SENSOR pad via a length of hookup wire. Any type of metal will work, including aluminum foil. The method of connecting the wire to the sensor plate depends on the metal you use. If you chose aluminum, you will need to fasten the wire mechanically because it won't accept solder. Copper and steel (except stainless) can be soldered.

Power Supply

The power requirements for the touch switch are 6 volts at 30mA. In our experiments, we used either four "AA" batteries wired in series or a six-volt AC-to-DC wall adapter (Radio Shack 273-1454; Digi-Key T305-ND). The power connects to the circuit board at the +PWR and -PWR pads.

If you wish, you can roll your own power supply using the schematic shown in Figure 1. The parts will cost about $8.00 not counting the enclosure. Unfortunately, the LM7806 voltage regulator isn't stocked by Radio Shack stores, and has to be special-ordered. However, with a minor loss of sensitivity, you can replace it with a 7805 (276-1770) five-volt regulator, which you can find on the racks of your local Radio Shack.

Button It Up

The final step is to place your project in a suitable enclosure. What I did was to slip the completed circuit board into the base of a table lamp and use the metal base as the sensor plate. We spliced the relay into the incoming line cord, as was the power supply. To turn on the lamp, we simply touch the metal base; touching it again turns the lamp off. The finished product is a very handy bed lamp.

Of course, you can use any enclosure you wish. Because the AC load side of the circuit isn't on the circuit board itself, there is no shock hazard – as long as you dress the AC wires properly with shrink tube insulation. However, avoid the temptation of replacing your wall switch with one of these; it isn't UL approved and, if it should cause a fire, your insurance company would be off the hook.

Making Changes

The unit described above is an AC line controller, designed to switch AC appliances up to 300 watts. However, a couple modifications to the design can change its complexion completely.

For example, you can replace the solid-state relay with a mechanical relay (Radio Shack 275-232) and switch DC loads, as well as AC. The problem with solid-state relays is that they contain triacs – semiconductor switches that latch ON when used with DC voltage. To break the latch, the load current must be interrupted, something the AC line does 60 times a second, but something you have to do manually with DC current. Mechanical relays don't care if it's AC or DC.

To use a mechanical relay in place of the solid-state relay, remove R2 and replace it with a jumper wire. Now attach the relay coil to +RL1 and -RL1; polarity isn't important. Finally, solder a 1N4001 diode across the relay coil as shown in Figure 4. This snubs back EMF (electromotive force) voltages that could damage IC2.

Because the touch switch is battery-powered, it can be used in remote locations, such as vacation cabins and aboard ships – places where AC power doesn't exist. For applications like this, though, you will have to change the sensor slightly. Ordinarily the switch receives its cue from the stray 60-Hz hum that the body picks up from normal house and office wiring (see "How It Works" for an explanation).

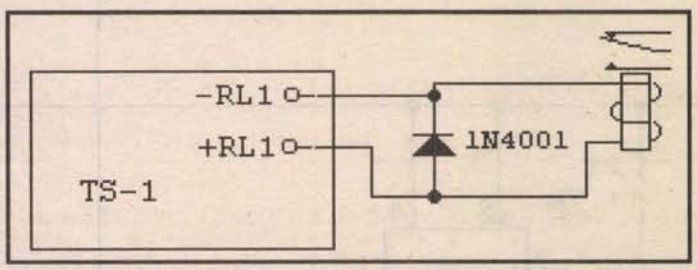

Figure 4. You can substitute a mechanical relay for the solid-state relay if you replace R2 with a jumper and add a damper diode to protect IC2.

Due to the absence of this signal, you will have to provide a signal of your own by providing a path from pin 2 of IC1 to ground. This is easily done using a small piece of printed circuit board that has been scribed in half either through chemical etching or with a hobby knife or hacksaw. What you want to do is have two areas of copper separated by a small gap. One side goes to pin 2 and the other to ground. Placing your finger on the gap completes the circuit and triggers the switch.

That's it! Feel free to experiment. Just be careful that you don't mix the AC voltages with those of the touch switch and you'll be okay.

This is Andy A. Node signing off 'til next month. Have fun! **NV**

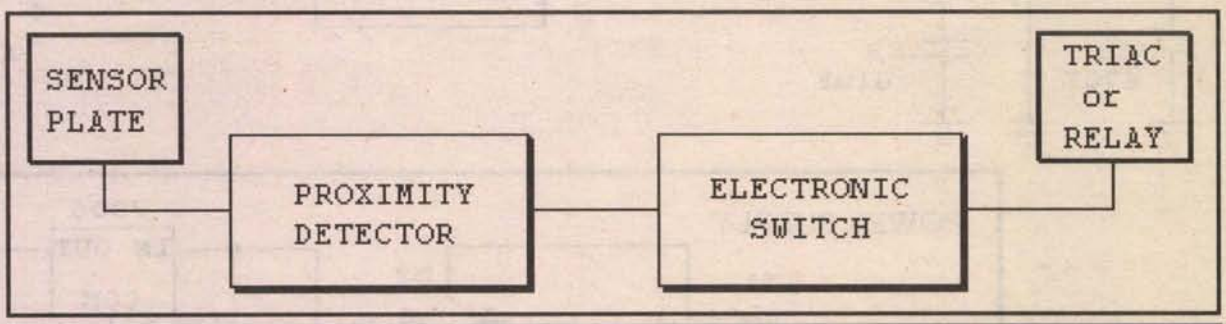

Figure 5. Block diagram of the touch switch.

THE WEEKEND WORKBENCH

THE WEEKEND WORKBENCH

Parts List

	Description	Radio Shack	Digi-Key
Semiconductors			
IC1	555	276-1723	LM555CN-ND
IC2	74HCT74	276-2816	CD74HCT74E-ND
D1	1N4001	276-1101	1N4001GICT-ND
Resistors			
R1	4.7K	271-1330	4.7KQBK-ND
R2	330 ohms	271-1315	330QBK-ND
Capacitors			
C1	0.22uF	272-1066	EF1224-ND
C2	47uF	272-1027	P5230-ND
C3	.01uF	272-1065	EF1103-ND
Misc.			
RL1	3A Solid-State Relay	275-005	GH7002-ND
RL1 (see text)	1A Reed Relay	275-232	Z530-ND
Power Supply			
D2	200V, 1A bridge	276-1161	DF04MGI-ND
IC3	7806	RSU 11392008	NLM78M06FA-ND
C4	47uF	272-1027	P5230-ND
C5	1uF	272-1434	P2105-ND
T1	12.6V Power Transformer	273-1385	T108-ND

Note: You can buy an etched and drilled printed circuit board for the touch switch from **Circuit Design, P.O. Box 5415, Central Point, OR 97502 (541-664-7904; http://www.cdsnet.net/Business/circuits/)**. The price is $6.00 plus $1.00 S/H ($3.00 for Priority Mail). Request part number TS-1.

How It Works

A touch switch is two, two, two circuits in one (Figure 5). First is the sensor or proximity detector. This circuit detects the presence of your finger or thumb by noting a change in capacitance at the electrode or by using your body as an antenna to pick up stray electromagnetic fields — typically 60-Hz hum radiated by the wiring in your home or office.

Our touch switch uses the latter — hum from power lines — to trigger the switch. IC1 (Figure 1) — a 555 timer — is the proximity detector. When you touch the sensor plate, your finger sends a 60-Hz signal to the trigger input, pin 2. This signal causes the output, pin 3, to go high. IC1 is configured as a monostable multivibrator. This means that once triggered, the output will remain high for a defined period of time, determined by R1 and C2.

Once triggered, C2 charges through R2 until it reaches 2/3 Vcc, about four volts. After the time expires — about one second — the output goes low and the multivibrator waits for the next trigger. This time delay is needed to prevent the output from "chattering" 60 times a second while your finger lingers on the sensor plate.

The switch (IC2) is a 74HCT74 D-type flip-flop. Pulse this circuit once, and it's on; pulse it again, and it's off – just the ticket we need. This particular flip-flop is triggered on the positive edge of the input pulse. That's to say that it doesn't recognize the on/off state of our proximity sensor. It only reacts when the pulse goes from low to high. The output of the flip-flop drives the LED inside the solid-state relay which, in turn, causes the triac to conduct. IC2 can sink up to 20mA of current, which is sufficient to pull in the optional mechanical relay if R2 is replaced with a jumper wire.

THE WEEKEND WORKBENCH

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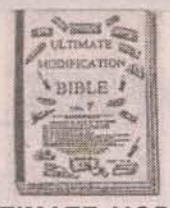

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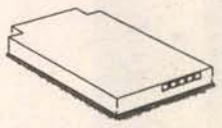

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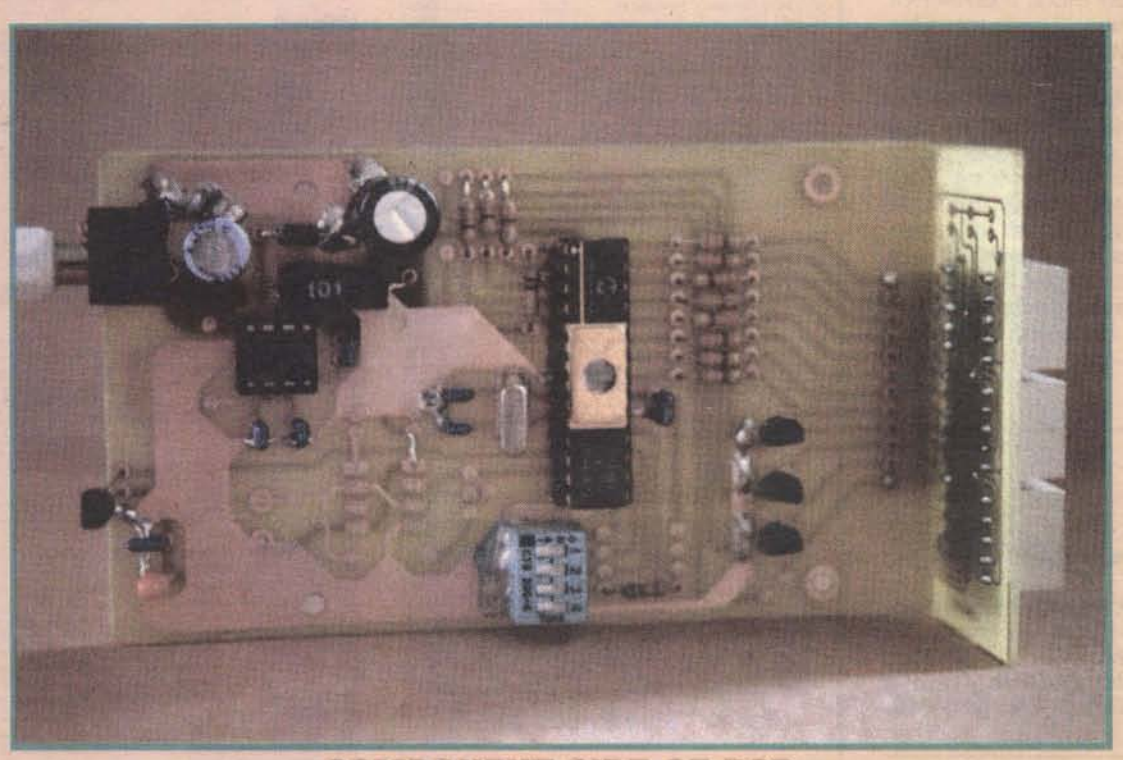
INDOOR THERMOMETER

by Richard Panosh

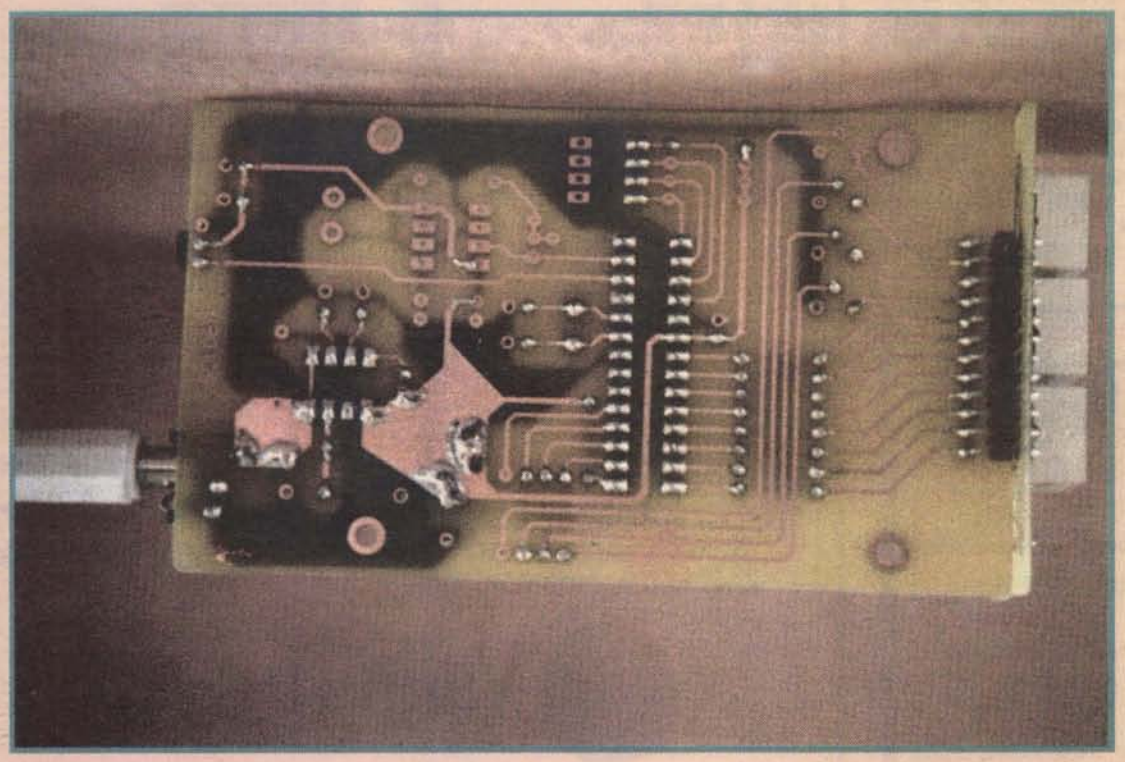
Around 1714, there was a great deal of confusion about what was considered hot or cold. Some contemporary thermometers had as many as 12 different scales marked on a large wooden board behind the instrument.

At this point, Daniel Gabriel Fahrenheit made his mercury thermometer and settled on the boiling point of water as 212 degrees, and the melting point of water as 32 degrees. His system was adopted by the majority of scientists and became the standard.

Today, you can build a digital indoor thermometer that can display temperature either on the traditional Fahrenheit scale or the Celsius scale with an easily read green 0.58" LED display. The display can be easily seen from a distance of 20 feet, and employs an Analog Devices TMP04 temperature sensor.



COMPONENT SIDE OF PCB



SOLDER SIDE (Note header on bottom for LED display board)

Circuit Description

The schematic diagram for the thermometer is shown in Figure 1. The circuit is powered from a 6-15V DC wall transformer. Internally, this voltage is dropped and regulated to +5V by IC1, a Maxim Max738A switching regulator. The switching regulator operates at better then 85% efficiency at converting the input power to reduce internal self-heating that will effect the temperature reading.

Since each segment of the LED display is operated at 15 mA for high brightness, a 0 display with six elements active will require about 90 mA total current. If a linear regulator were used, it would dissipate over a half watt dropping from 12V to 5V.

U3 is the Analog Devices TMP04 temperature sensor. This is a three terminal device mounted in a conventional TO-92 transistor-style package. Pin 1 supplies the temperature in the form of a pulse width modulated squarewave; pin 2 supplies power; and pin 3 is the IC ground pin. The high time of the squarewave is approximately 10 msec long, while the low pulse time is a function of temperature. The output pulse time is easily related to temperature by the following equations:

$$T_F = 455 - \left[\frac{720 * t_{hi}}{t_{lo}}\right]$$

$$T_C = 235 - \left[\frac{400 * t_{hi}}{t_{lo}}\right]$$

This ratiometric reading allows the temperature sensor to output the temperature data on a single pin without the use of a master clock signal or an accurate onboard clock.

The brains of the thermometer is provided by a Microchip PIC16C63 microprocessor. This microprocessor is equipped with a 16-bit timer and a capture/compare mod-

ule. The capture feature is used as an interrupt to latch the pulse rise and fall times of the square-wave to calculate the duty cycle of the temperature sensor and solve the above equations for the temperature. In addition, the microprocessor is interrupted every seven milliseconds to refresh the LED display digits.

All calculations are performed in double precision unsigned binary arithmetic (16 bit) to display the temperature from essentially 0° to 99.9° in either Fahrenheit or Celsius. Multiplication and division routines which may require several hundred reiterations are still executed in about one-half millisecond since the microprocessor is running close to one instruction per microsecond. This would allow for a temperature update of nearly 20 temperature readings per second.

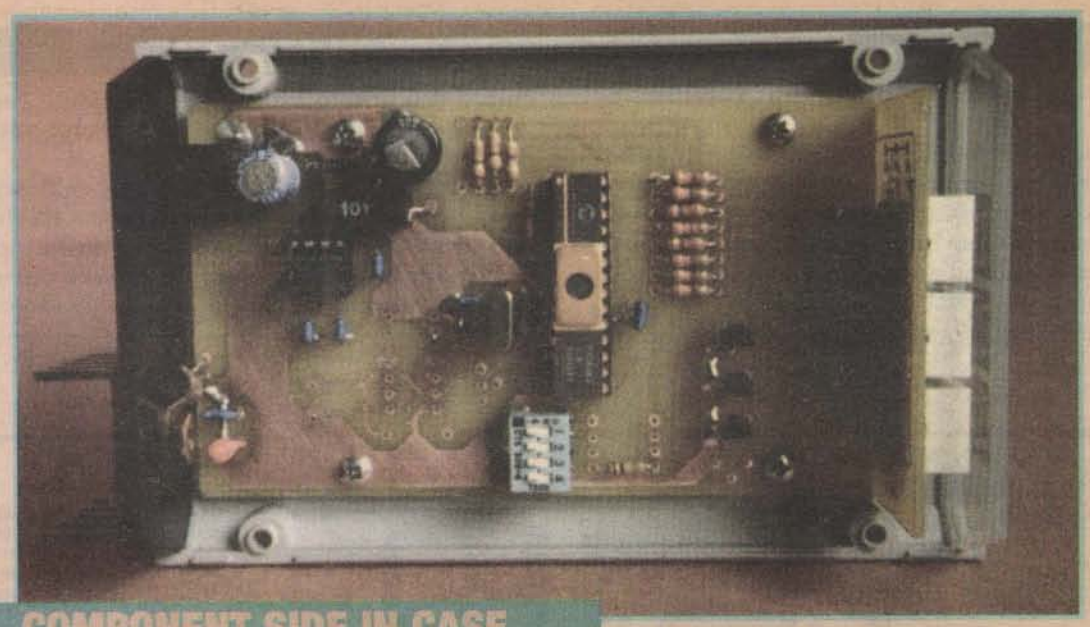
Instead, the display routine is slowed down by a delay loop to sample only once every couple seconds. The binary number is converted to BCD and then to the required bit pattern to light the individual seven segment LED display.

The display is multiplexed with all the a-elements wired together, all the b-elements, etc., to reduce the number of drive signals to eight (this includes the decimal point) which are sourced by port B. The resultant high current produced by driving multiple segments of a digit are current-sinked by transistors Q1-Q3. These transistors are switched by a portion of port A.

Port C contains the capture input pin, as well as reads the position of switch S1, to calculate either Fahrenheit or Celsius units for the display. This switch is only read during the initial power-up of the microprocessor, so that changes made while running will not alter the display units.

Program

The source and object code for the microprocessor is available or a completely preprogrammed microprocessor is available on the *Nuts & Volts* web site from the parts list.



COMPONENT SIDE IN CASE

AD TMP04 MOUNTED IN METAL CLIP TO HEATSINK ON REAR

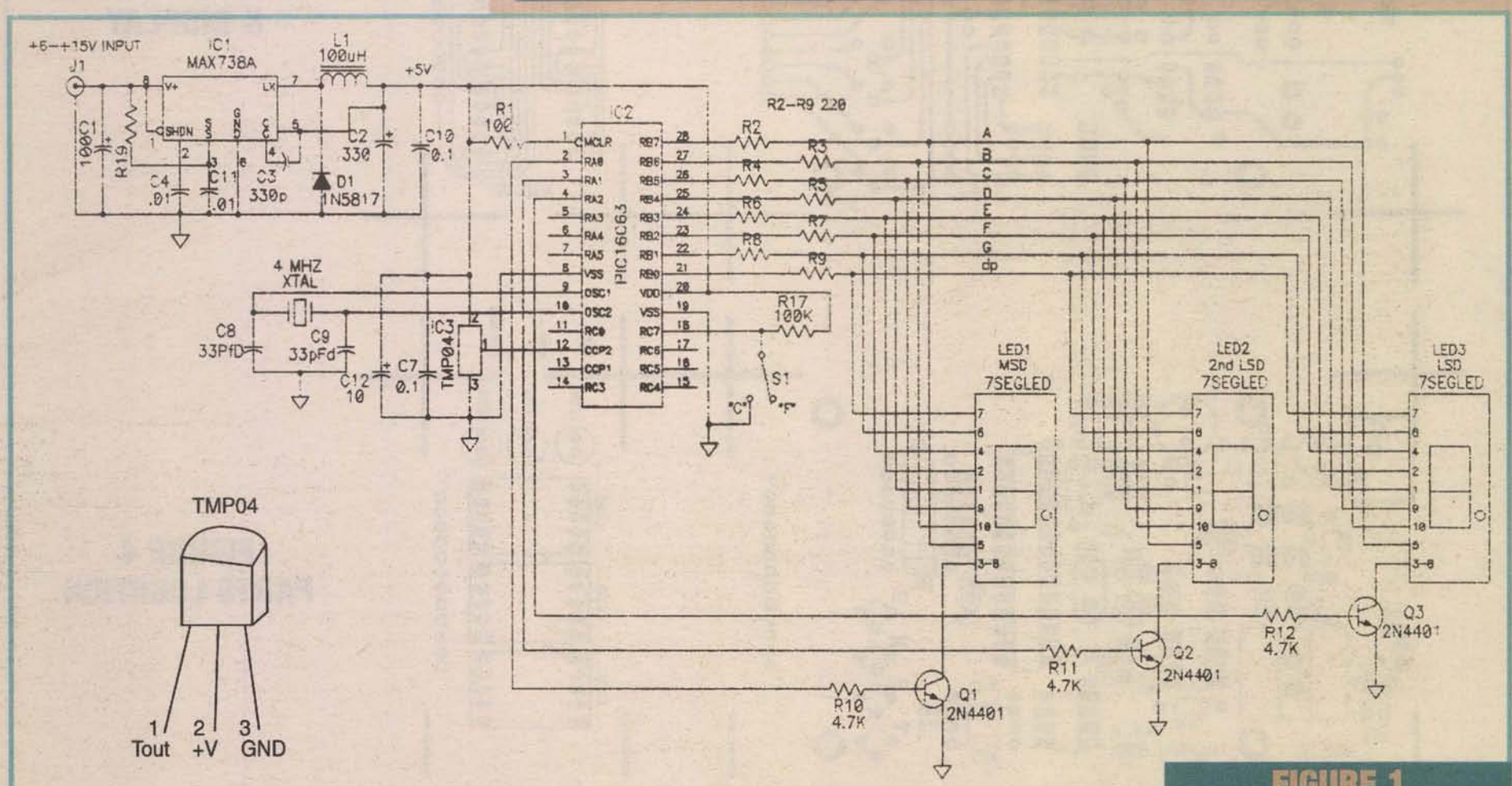


FIGURE 1

Construction

The author's prototype thermometer was built on a double-sided printed circuit board. A pre-etched board, drilled with plated holes and silk screen, is available from the parts list. This board has been designed with the placement of additional components which are not required in this project. If you wish to make your own, Figure 2 and Figure 3 provide the artwork for a double-sided printed circuit board.

The board is sized to fit a Serpac A-27 style enclosure with a clear lens. Parts layout for the prototype is shown in Figure 4. The digital design is not critical, and any construction technique may be used, such as perfboard or wirewrap. Some special care may be required if an alternate construction method is used with the Maxim switching regulator, since it operates at about 160 KHz.

Start by soldering the sockets and dip switch to the main board. The dip switch may be omitted if a fixed Fahrenheit/Celsius display is desired. If the S1 terminals are left open, the default display will be in Fahrenheit. If these terminals are shorted

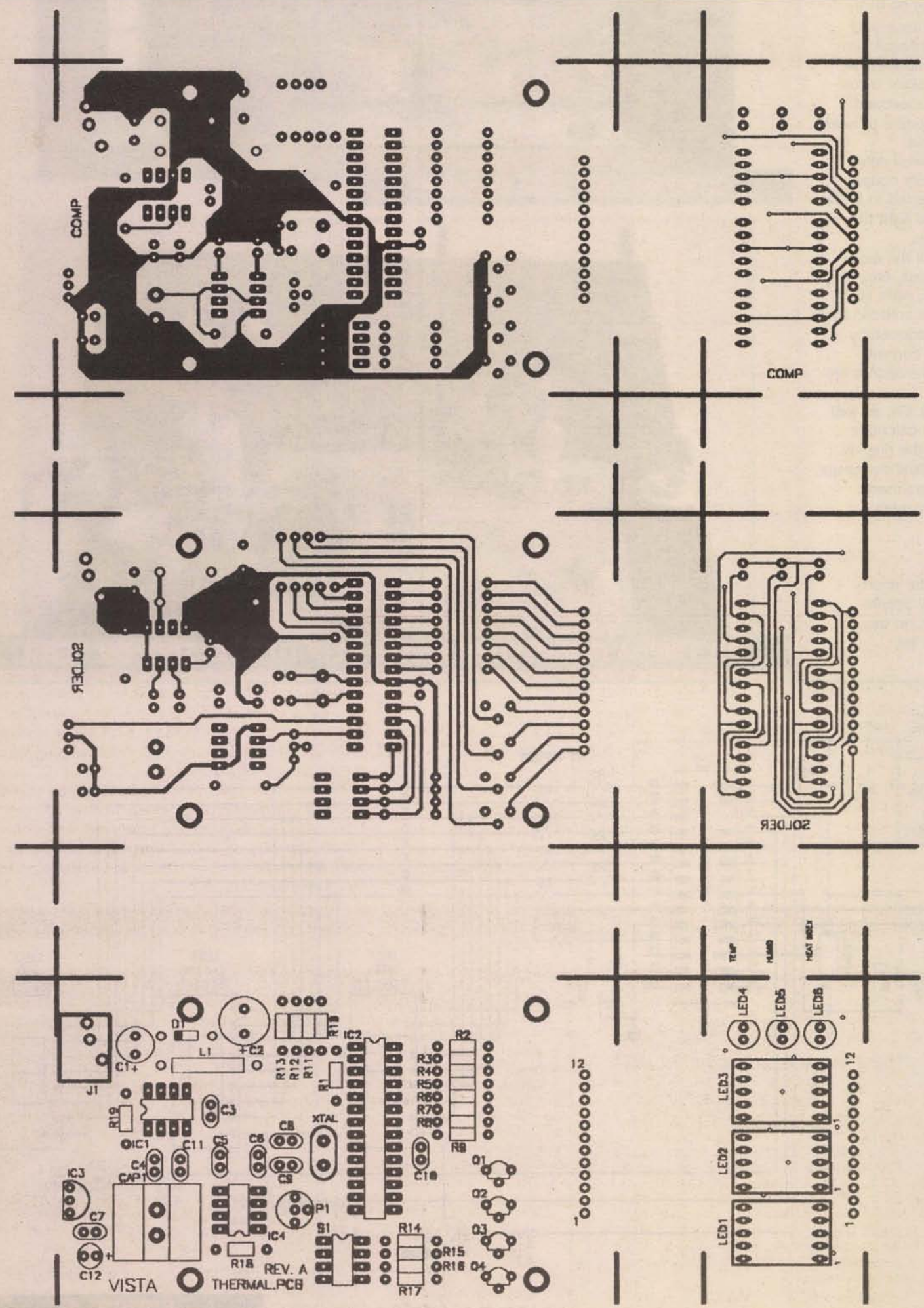


FIGURE 2
COMPONENT SIDE OF MAIN BOARD & DISPLAY

FIGURE 3
SOLDER SIDE OF MAIN BOARD & DISPLAY

FIGURE 4
PARTS LOCATION

with a jumper, the display will read in Celsius.

Next, mount the resistors, diodes, inductor, capacitors, and transistors. Observe polarities on the diode, transistors, and electrolytic capacitors. The inductor should be made with a ferrite core (not powdered iron).

In addition, the inductor should be rated for about 150 mA. Mount the crystal a little bit above the board so that the metal case doesn't touch any of the board traces.

Remove about 1/8" off the leads of the TMP04 sensor. It is mounted standing up at the rear of the printed circuit board. This allows the sensor to be mounted flat against the rear of the case. A single hole is drilled in the rear panel which allows a 6-32 brass machine screw and nut to secure a metal wire clamp (Allied 920-1471) around the sensor located inside the case to a TO-220 heatsink (Radio Shack 276-1363) located outside the case.

This mounting technique allows the sensor to more accurately measure the ambient temperature outside the case, and gives it a reasonable response time. It should be noted that the TMP04 dissipates about 4-5 mW which causes a self-heating of about 1.3°F in free air due to the epoxy case.

In addition, a larger temperature offset will occur within the case due to the additional heat dissipation of the reaming components. To maintain accuracy, it is required that the same mounting technique be employed.

The final design was calibrated against a thermal couple temperature controller, and the intercept point was reduced by 3°F from that presented in the above equations.

Mount the three seven-segment LEDs to the display board. The display element's pinout must correspond to the board layout (Digi-Key LU94025 Common Cathode). Green display elements are preferred because they are easier on the eyes, although any color may be used.

The display board is made to attach to the main board by means of a 12-terminal 0.156" spaced right angle header (Digi-Key WM4110). The straight section with the plastic bar should be mounted to the solder side of the display board and soldered from the component side. The curved portion of the header is then inserted through the holes of the main board from below (the solder side) and soldered from the silkscreen side. This will result in the proper display height and set back for the Serpac A-27 case. If a suitable header is not available, you may connect the two boards together with a ribbon cable or bare wire leads.

Bill of Materials — TEMP.PCB

	Quantity	Value	Ref Designators
CAPACITORS			
	2	33 pFd	C8,C9
	1	330 pFd	C3
	3	0.1 uFd	C4,C7,C10
	1	10 uFd, Tant	C12
	1	100 uFd/16V	C1
	1	330 uFd/High freq.	C2
SEMICONDUCTORS			
	1	1N5817	D1
	3	2N4401	Q1,Q2,Q3
	3	7-SEG NUM. DISPLAY (Digi-Key LU94025 Common Cathode)	LED1,LED2 LED3
	1	MAX738A	IC1
	1	PIC16C63	IC2
	1	TMP04	IC3
RESISTORS			
	8	220	R2,R3,R4,R5,R6 R7,R8,R9
	3	4.7K	R10,R11,R12
	2	100K	R1,R17
MISCELLANEOUS			
	1	2.5 mm POWER JACK	J1
	1	4 MHz	XTAL
	1	100 uH, 150 mA ferrite core	L1
	1	S.P. DIP SWITCH	S1
	1	VISTA TEMP.PCB	
	1	VISTA DISPLAY.PCB	
	1	+12V WALL XFORMER/100 mA	
	1	28-PIN DIP SOCKET	
	1	8-PIN DIP SOCKET	
	1	SERPAC A27 CASE	
	1	12 Position 0.1" HEADER (Digi-Key WM4110)	
	1	KESTER 331 SOLDER	
	1	TO220 HEATSINK, Screw, nut & clamp (Radio Shack 276-1363) & (Allied 920-1471)	

TOTAL 46 PARTS

The following parts are available from **Vista**, P.O. Box 1425, Bolingbrook, IL 60440-1532 **(630)-378-5534**.

- Complete Digital **TEMP-ASSEM** and tested for **$89.00**
- Complete Digital **TEMP-KIT** containing all parts with case for **$72.00**
- **TEMP-SOFTWARE** source program on 3.5" floppy for **$19.95**
- **PIC16C63** Pre-programmed microprocessor for **$15.00**
- **TMP04** IC for **$7.50**
- **MAX738A** IC for **$7.50**
- Vista Digital **TEMP-BRD** board for **$13.00**

All mail orders will be shipped by first class US mail with a shipping and handling charge of $3.00. All phone orders will be shipped by US priority mail with a shipping and handling charge of $6.00. Illinois residents must include 7.5% sales tax.

To prevent the leads from breaking from fatigue, the front display board may be mechanically attached with a bracket or epoxy glue.

After completing the assembly, carefully check your work for cold solder joints and solder bridges. If you make your own board, make sure that both sides of a lead are soldered for continuity from the top traces to the bottom traces where required. This is especially important on the display board were the plated hole vias are used to transfer the signals from one side of the board to the other side of the board without a component lead present.

The DC wall transformer can supply from 6V to 15V, and must be capable of at least 100 mA continuous rating. Voltages above 15V will exceed the rating of the MAX738A switching regulator. The power connector at the rear of the main board is designed for a 2.5 mm hollow barrel plug with the center pin positive.

It is always good practice to clean the printed circuit board thoroughly. Install the integrated circuits into their sockets and power the thermometer up. The display should immediately light up with the temperature in the proper units selected by S1 at power-up. **NV**

COMPUTER HARDWARE *cont.*

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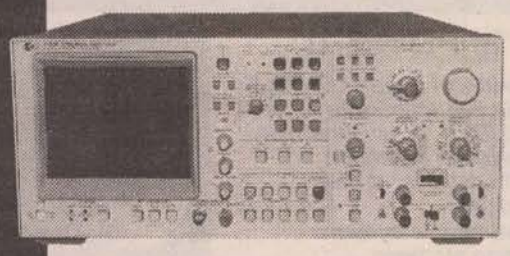

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Build a PIC-based Electronic Stopwatch with Giant 2.5" LED Display

by Scott Edwards

The Jameco JE725 electronic clock kit is a thing of beauty. It's inexpensive, compared to a comparable giant-digit commercial clock. It's easy to build, thanks to a clean layout and truly huge 3.5 by 17.5-inch printed circuit board. And, once assembled, the proud kit builder has no trouble explaining to non-technical folks what it is; it's a clock.

This project adds another dimension to the nifty JE725 by converting it to a stopwatch with 2.5-inch-tall digits. It keeps time to the nearest 1/100th of a second for intervals as long as 59 minutes, 59.99 seconds. The clock's built-in pushbuttons, previously used to set the time, now serve as start, stop, and reset buttons.

The modifications required to convert the clock to a stopwatch are designed to plug into the clock chip's socket. Restoring the kit to clock operation is just a matter of unplugging the adapter board and re-installing the clock chip.

The clock-to-stopwatch converter is based on an inexpensive PIC16C55 microcontroller and a few support components. This article includes the commented PIC program and printed circuit board (PCB) layout. All of the files connected with this project, including the PCB files, are available through the *Nuts & Volts* web site. In short, aside from the components themselves, everything connected with this project is utterly free!

Designing the Stopwatch Adapter

The Jameco JE725 clock is based on an MM5314 CMOS clock chip. This IC includes all of the logic necessary to create a simple digital clock. It derives its timing from an AC power line, or some other stable 60-Hz source, and has switch inputs that allow you to set the time. As this chip is somewhat old, I was unable to find much more information on it, but it appears that it could probably directly drive a small LED display. The LED display on the JE725 is anything but small, so its designer added additional driver circuitry. In any case, the MM5314 chip uses a common scheme – called multiplexing – to keep the hardware needed to drive the display to a minimum.

Figure 1 shows the basic idea. Each display digit is made up of seven segments – or LED-illuminated bars – that can be selectively lit up to represent the numbers 0 through 9. For example, lighting all seven segments gives a reasonable facsimile of the number 8. Since this is an easy way to convey numbers, seven-segment displays using LEDs, liquid crystals (LCDs), filament lamps, and various mechnical gadgets are everywhere. My local convenience store even has a human-powered version – clerks fill in prices on store signs by using a black marker to cover up unused segments.

Using seven-segment displays to convey six digits worth of data requires controlling 6 x 7 = 42 individual lights. The MM5314 clock chip uses multiplexing to do the job with just 13 connections. Look at Figure 1. All of the digits share a common set of segment-control lines. For example, the line that carries the + supply voltage to the top segment of the first digit also serves the top segment of the second digit, and the third, and so on. Of course, to light these segments, you have to complete the circuit to ground. That's the function of the lines labeled "digits" in the figure.

So, we can light up any combination of segments of a particular digit by applying + to the segment lines and ground to the desired digit line. That gets us to the point that we can display one digit at a time; how do we get all six digits to display a sequence like 123456? Piece o' cake; just put + on the segment lines that make up the 1 and ground the leftmost digit line; then switch the segments to form 2 and ground the second digit; then 3 and ground the third digit ... Do this fast enough, and the human eye is fooled into seeing all six digits lit up at once. That's multiplexing, and the MM5314 clock chip does it automatically. Later, we'll see how to program the PIC to achieve the same effect.

Figure 2 shows the actual driver circuitry that interfaces the clock chip to the display. Since all of the segment drivers and all of the digit drivers are identical, the figure just depicts one example of each. The circuit uses common NPN transistors for both the segment and digit drivers. The portion of the circuit shown controls the bottom bar of the leftmost digit. In order for the LED to light, both Q10 and Q1 must be turned on by applying a current-limited + to their bases. From the clock chip's point of view, that means outputting a logic 1 (+12V) to the base of Q10, and a logic 0 (0V) to the input of the 4049 inverter/buffer. True to its name, the inverter inverts the 0 to a 1 and turns on Q1.

Now that we see how the clock chip controls the LEDs, we're ready to program its substitute, a PIC16C55. Figure 3 is a schematic of the PIC circuitry.

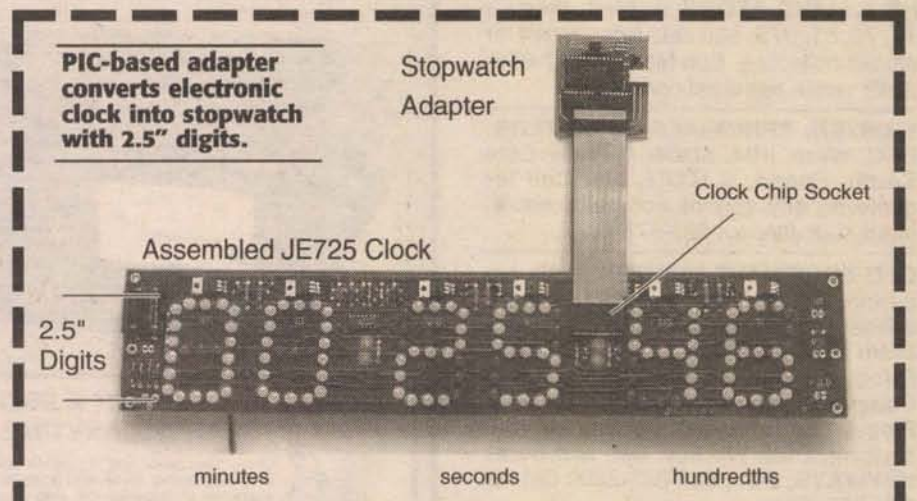
A basic design responsibility is to make the five-volt PIC compatible with the 12-volt clock circuit. The first step is simple – just run the 12-volt supply into a five-volt regulator consisting of U4, C3, and C4.

The second step is to make the PIC's five-volt logic outputs compatible with the 12-volt logic of the clock. There are lots of ways to do this, including buffer circuits designed specifically for the purpose. I chose to use a couple of ULN2003 inverter/driver arrays. These ICs contain seven identical circuits, each consisting of a husky NPN transistor switching to ground in an open-collector configuration. When there's a logic 1 at the input (base of the triangle in the schematic symbol), the output pulls to ground (0V). With a logic 0 at the input, the output floats (acts as though it were disconnected). By connecting the output to +12V through some resistors, the output of the ULN2003 can swing from 0 to +12V under the control of the PIC's five-volt input.

Programming the PIC Stopwatch

Comments in the program listing describe the nitty-gritty details of stopwatch operation; here we'll hit the high spots. Please note that this pro-

PIC-based adapter converts electronic clock into stopwatch with 2.5" digits.



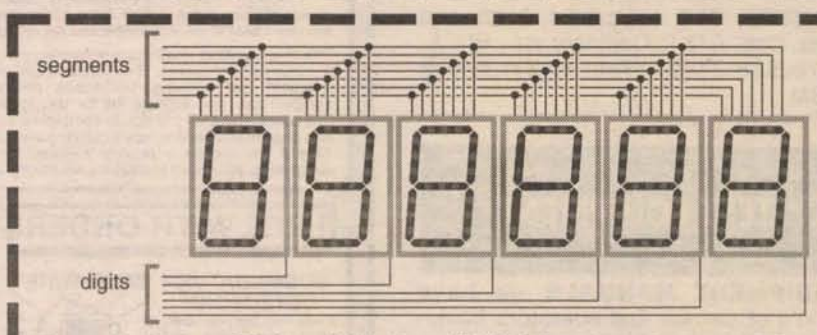


Figure 1. In a multiplexed display, all digits' segments connect to a common bus.

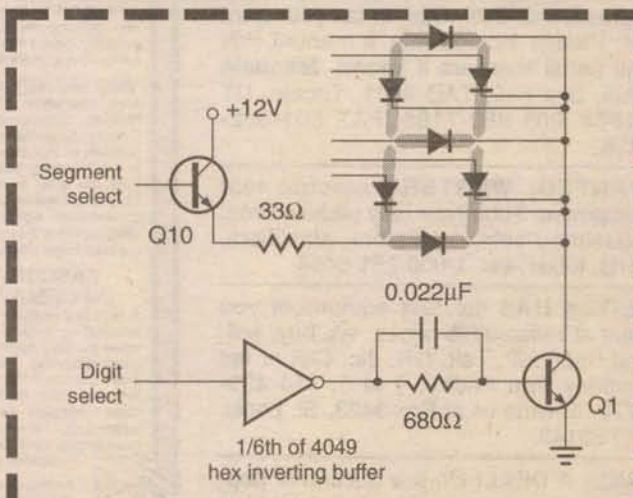
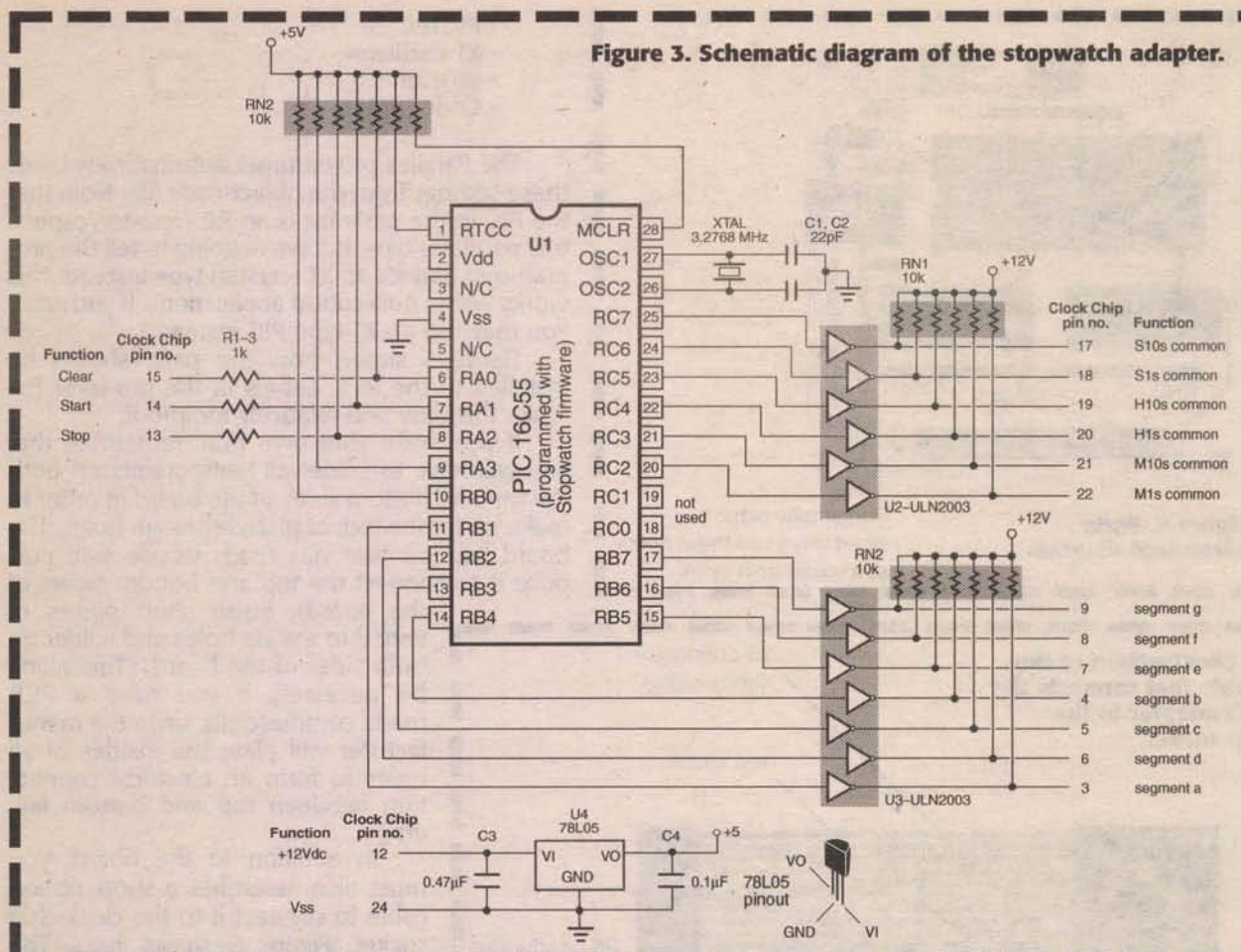


Figure 2. Partial schematic of the JE725 clock's display-driver circuit.

Figure 3. Schematic diagram of the stopwatch adapter.



gram is written in the Parallax dialect of PIC assembly language, which is somewhat different from the manufacturer's (Microchip's) dialect. The project file, available from www.nutsvolts.com, contains both the Parallax source, and hex object files.

The PIC's primary job is to display six values, representing the ones and tens digits of the minutes, seconds, and hundredths of a a second, on the LED display. The most basic aspect of this is taking a number from 0 to 9 and translating it into the appropriate pattern of segment for the LEDs. Because of the inverting nature of the ULN2003, a 1 on a segment output turns the segment off; a 0 turns it on. A second, similar aspect of maintaining the display, is translating a digit number (0 through 5) into an output that turns on that digit (and only that particular digit).

These jobs are handled with look-up tables named LEDsegs (segments) and LEDdigs (digits) in the program listing.

Ignoring the stopwatch function for a moment, the main program loop consists of the following sequence:

- Blank all segments.
- Translate the current digit number (0-5) to a bit pattern that will turn on just that digit.
- Write that bit pattern to the digit-select outputs.
- Point to the memory location containing the value (0-9) for the current digit number.
- Get the digit value (0-9).
- Translate the digit value to a pattern of LED segments.
- Write that bit pattern to the segment outputs.
- Wait briefly.
- Increment the digit number. If the digit is greater than 5, then digit = 0.
- Go back to the first step.

Table 1

```
mov     w,digit         ; Put digit number in w.
call    LEDdigs         ; Go to subroutine LEDdigs.
mov     rc,w            ; Write the digit-select pattern to rc.
; ... program continues...
LEDdigs                 ; The lookup table.
jmp     pc+w            ; Jump w instructions ahead.
retw    01000000b       ; If w=0, return with 01000000b.
retw    10000000b       ; If w=1, return with 10000000b.
retw    00000100b       ; If w=2, return with 00000100b.
retw    00001000b       ; If w=3, return with 00001000b.
retw    00010000b       ; If w=4, return with 00010000b.
retw    00100000b       ; If w=5, return with 00100000b.
```

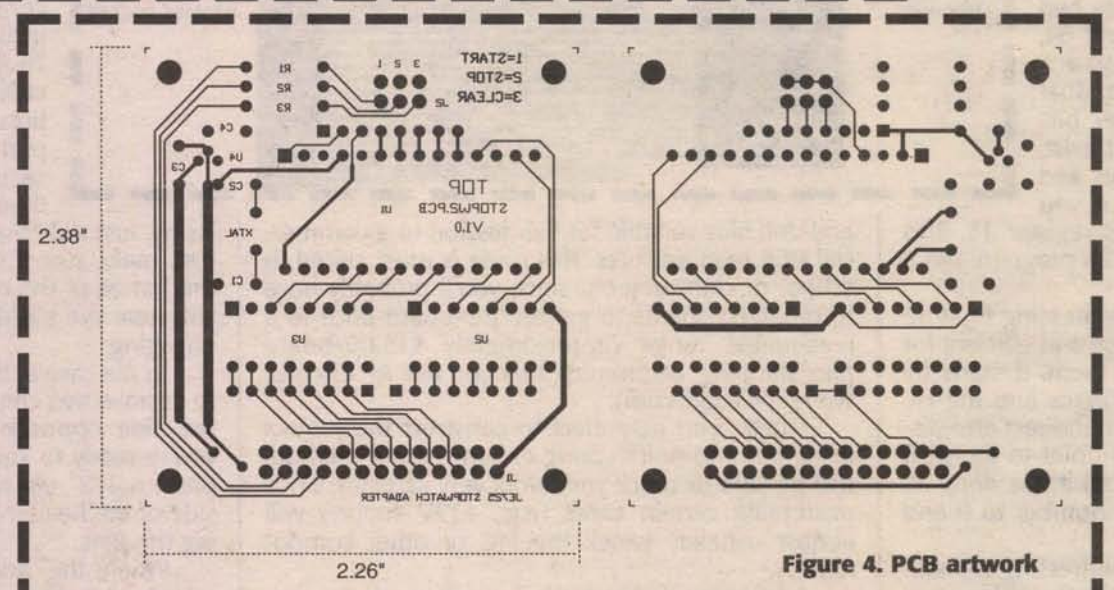


Figure 4. PCB artwork

matically increment every n instruction cycles (where n is a power of 2; 2, 4, 8, 16, 32, 64, 128, or 256). In this program, the timer is set to increment every 256 cycles. The PIC's internal clock is governed by a 3.2768-MHz crystal, and an instruction cycle occurs every fourth clock cycle, or 819.2 KHz. Divide that by 256 and you get 3200 Hz, the rate at which the timer increments. The program watches bit 5 of the timer value, which changes with every 32nd tick of the timer. When that bit rolls over, 1/100th of a second has elapsed. There's our stopwatch timebase.

Every 1/100th of a second (if the stopwatch is running), the program increments the current time. The time is stored as six bytes, each representing a digit of the time. Incrementing the clock goes like this:

- Hundredths = hundredths + 1
- If hundredths > 9 then hundredths = 0 else done
- Tenths = tenths + 1
- If tenths > 9 then tenths = 0 else done
- Seconds_ones = seconds_ones + 1
- If seconds_ones > 9 then seconds_ones = 0 else done
- Seconds_tens = seconds_tens + 1
- If seconds_tens > 5 then seconds_tens = 0 else done
- Minutes_ones = minutes_ones + 1
- If minutes_ones > 9 then minutes_ones = 0 else done
- Minutes_tens = minutes_tens + 1
- If minutes_tens > 5 then minutes_tens = 0 else done
- Done: go back to scanning the display

The logic of this sequence is the same as counting on your fingers, with the exception of the adjustments for the way that minutes and seconds roll over from 59 to 00. Note that the numbers 0-9 can and commonly are stored more compactly as nibbles (four-bit values) instead of bytes (eight-bit values). However, since the PIC deals most efficiently with bytes, and since this program has more RAM available than it really needs, we're using bytes instead.

The only remaining details are the three switches that start, stop, and clear the stopwatch. If you blink while you read the program listing, you'll miss this part. The start and stop buttons set and clear a bit called goFlag, which the program uses to decide whether or not to increment the current time. The state of the clear button just determines whether the program should call a subroutine that writes 0s to all of the digit values. That's it.

So that sequence takes care of displaying six digit values (0-9) on the LEDs. All that's left is to generate those values, which represent the current state of the stopwatch.

Basically, a stopwatch is nothing more than a counter that is triggered to increment (count upward by 1) at precise intervals. In this case, the interval is 1/100th of a second. The interval is set with the help of the PIC's internal timer, known as timer 0 (TMR0) or RTCC.

By setting bits in the PIC's option register, you can make the timer auto-

Two PIC features are central to the operation of this program: relative addressing of program memory, and indirect addressing of data memory. We glossed over them in the previous discussion; let's look at them more closely now.

Relative addressing – as implemented in the PIC – just means adding the value stored in the working register (w) to the current value of the program counter. Since the program counter points to the next instruction to be executed, this trick lets you jump 0 to 255 instructions forward into the program. This is useful for look-up tables and jump tables. A look-up table takes a value in w and uses it as an index to look up a value from a list of values stored as retw instructions. Retw is short for "return with this value in w."

Here's an example snipped from the program. The situation is this: We have a digit number (0-5) stored in the variable digit. We want to retrieve the bit pattern that will turn on that digit. (The bit pat-

terns were worked out when the hardware was designed and written down as a list; 64 (01000000 binary) turns on digit 0, 128 for digit 1, 4 for digit 2 ...) The code looks like Table 1.

Note that, in the actual program listing, retw values are condensed into one instruction. The assembler lets you follow retw with a list of values, and it understands that you mean to precede each value with retw.

Retw isn't the only instruction that you can use with this method. You can also list a series of jumps so that the program goes to a given piece of code based on the value in w. Or, for very fine control of a time delay, you can jump into a table of nops (no-operation instructions). The farther into the table you go, the fewer nops the program executes, and the shorter the time delay. This is a tidy method of trimming a time delay down to one instruction cycle based on an input value.

The other PIC feature that the stopwatch program relies on is indirect addressing. Here you write a number to a special location called the file-select register (fsr), and the value stored at the address in RAM corresponding to that number shows up in another special register called indirect (indf in newer PICs). For example, if you write 14 to fsr, the value you find in indirect will actually be the contents of register 14.

One quirk of the fsr in older 5x PICs is that the upper, unused bits of the fsr read back as ones. For example, if you write the value 13 to fsr, then read back fsr, it will contain 205, not 13. The two highest bits, representing 128 and 64, always read as 1s in the PIC' 55, so any value written to fsr reads back as that value, plus 192. Since the upper bits would point to RAM that doesn't exist, the PIC uses only the lower 5 bits and ignores the others anyhow. So if you write 13 to fsr, indirect accesses register 13. This quirk does not affect the stopwatch program, but it is something to watch out for.

The program uses indirect addressing to store the digit values. That makes it easy and efficient for the scanDisplay loop to display them. It starts by placing the base address of the digits into the fsr, then retrieves this digit value from indirect and displays it. It then increments fsr to point to the next digit, and repeats the process until it has done all six digits. It then resets the digit number to 0 and starts again.

If it weren't for this indirect addressing capability, the code required to retrieve and display each digit would be much larger.

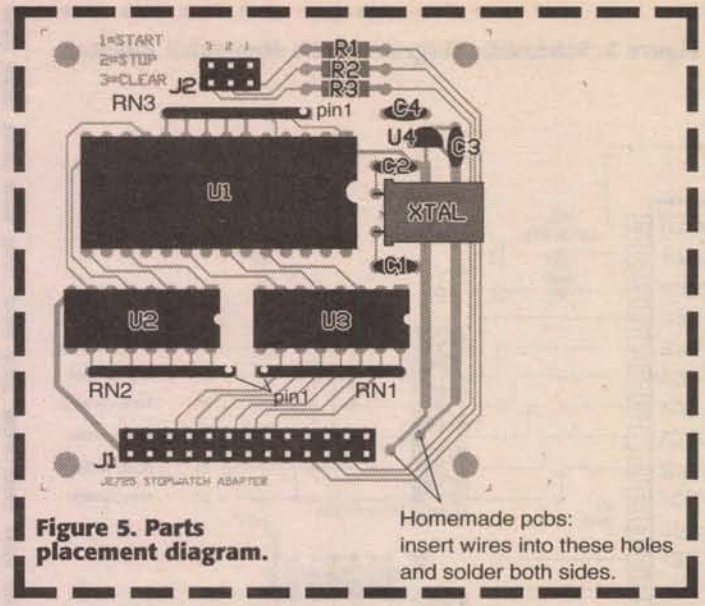


Figure 5. Parts placement diagram.

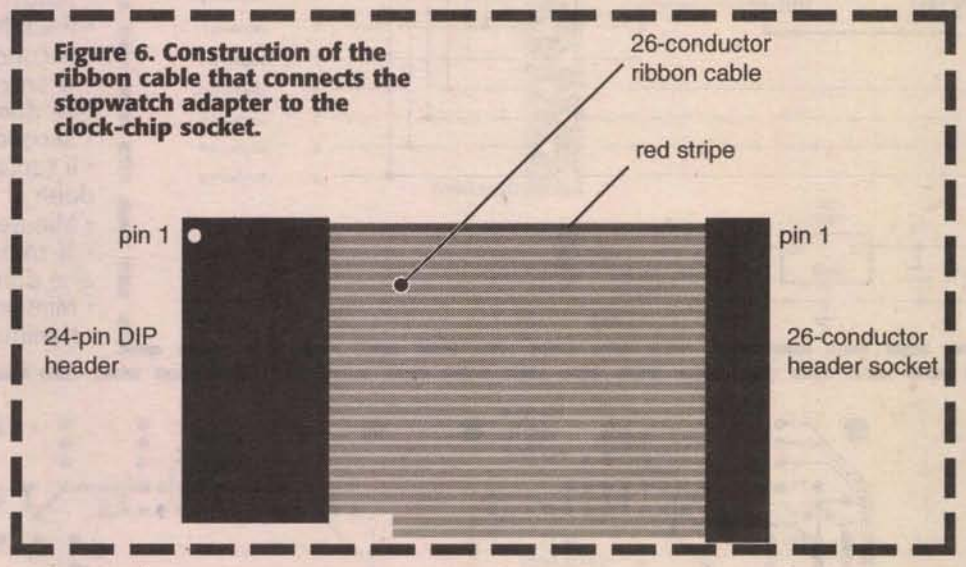


Figure 6. Construction of the ribbon cable that connects the stopwatch adapter to the clock-chip socket.

Building the Stopwatch

The JE725 stopwatch kit comes with great instructions, so I won't duplicate them here. To begin our project, you will need a working JE725. If you build the kit specifically for this stopwatch conversion, test its operation as a clock first. Once it's working properly, it is ready to use with the stopwatch adapter.

Figure 3 is the schematic diagram of the adapter circuit; Figure 4 is the PCB layout. If you want to make your own PCB, make sure to download the project archive for this article from www.nutsvolts.com. It contains everything you'll need, including an Adobe Acrobat copy of the PCB artwork that should print out superbly on your laser printer.

If you prefer not to etch and drill your own board, the archive also contains layout (Gerber) and drill files suitable for submission to a commercial PCB manufacturer. This route is most suited to school or club projects, since you'll probably have to order 10 boards to get the per-board price to a reasonable range (approximately $15.00/board plus shipping, assumming that you use AP Circuits, www.apcircuits.com).

Finally, you may elect to construct the project using point-to-point wiring or some other method. Just be sure to check your work very carefully, since misrouting certain wires (e.g., +12V supply) will almost certainly wreck the PIC or other components.

Speaking of the PIC, you will need to program it with the STOPW.OBJ file, using the Parallax PIC programmer (www.parallaxinc.com). If you have a Microchip programmer or equivalent, use the file STOPW.HEX instead. When you program the PIC with a non-Parallax programmer, you will have to set the device configuration manually as follows:

- PIC16C55
- XT oscillator
- WDT off
- Code protect off

The Parallax programmer automatically loads these settings from the object-code file. Note that the PIC in the parts list is an RC (resistor/capacitor) oscillator type, but we're going to tell the programmer that it's an XT (crystal) type instead. This works fine in non-critical applications. If you wish, you may use an XT-type PIC instead.

Figure 5 shows how the parts should be installed to the PCB. Labels in the top-layer foil make this easy and relatively foolproof.

If you make your own PCB, remember that you will have to solder all components on both the top and bottom sides of the board in order to make up for the lack of plated-through holes. The board has just two vias (pads whose sole purpose is to connect the top and bottom layers of the board). Insert short pieces of wire into the via holes and solder on both sides of the board. (This won't be necessary if you have a PCB made commercially, since the manufacturer will plate the insides of all holes to form an electrical connection between top and bottom layers.)

In addition to the board, you must also assemble a short ribbon cable to connect it to the clock-chip socket. Figure 6 shows how. The connectors are so-called IDCs – insulation-displacement connectors. They are squeezed onto the ribbon cable without stripping the insulation. Sharp teeth in the connectors puncture the insulation and make secure contact with the wires inside. If you don't have an IDC tool, don't worry. Just slide the ribbon cable into the slot in the IDC, make sure it's lined up squarely, and squeeze the halves of the connector together in a vise until you hear the slight click of the connector's latches engaging.

In the case of the 24-pin DIP header, make sure to remove two conductors of the ribbon cable from the side opposite pin 1 (see the figure). When you're ready to squeeze the connector in the vise, place a 1/2" square wooden block under the pin side of the header to prevent the vise from squashing the pins.

When the board and cable are assembled, remove the clock chip from the JE725 and connect the adapter as shown in the photo. When you connect power to the clock with the stopwatch adapter installed, the display will show 00:00:00. If it does not, immediately disconnect power and review your assembly work for errors.

Designator	Description (Jameco part no.)	Qty
R1-3	1K, 1/4 W resistor, 5% (29663)	3
RN1-3	10K, eight-pin bussed resistor network (97826)	3
XTAL	3.2768-MHz crystal (14525)	1
C1,C2	22 pF, 50 WVDC 5% ceramic disc cap (15405)	2
C3	0.47 µF, 50 WVDC mono/ceramic cap (25558)	1
C4	0.1 µF, 50 WVDC mono/ceramic cap (25523)	1
J1	2x13 straight male header (53495)	1
J2	2x3 straight male header (115035)	1
U1SKT	28-pin solder tail DIP socket, 0.6"W (112272)	1
U1	Programmed PIC 16C55-RC/P (134164)	1
U2,U3	ULN2003 Darlington array (34278)	2
U4	78L05 5V positive voltage regulator (51182)	1
J1SKT	26-cond. 0.1" double-row IDC socket (138333 or 32563)	1
J1CBL	6" length 26-cond. 28AWG ribbon, (37807; 25 ft.)	1/50
J1PLG	24-pin DIP IDC plug, 0.6"W (42690)	1
JE725	Jameco large-digit clock kit (105507)	1

Using the Stopwatch

The stopwatch adapter is designed to use the time-set pushbuttons on the clock board to control its functions:

Clock Function	Stopwatch Function
HR (set hours)	Reset to 00:00.00
MIN (set minutes)	Start
HOLD (stop clock)	Stop

Alternatively, you may use the pins of J2 to control the stopwatch. Connect pushbutton switches to the pin pairs marked 1, 2, and 3 respectively to start, stop, and clear the stopwatch.

Note that you may clear the stopwatch while it is running, and that stopping it does not

clear the time. You may restart from that time, or press clear to start over.

Sources and Parts List

All of the components needed for this project may be obtained from Jameco Electronic Components, www.jameco.com; phone 1-800-831-4242. Each part is listed with its Jameco part number. If you want to preview the instruction manual for the JE725 clock, it is available via the net from the following (very long!) URL:

ftp://ftp.jameco.com/jameco/manual-kits/105507je725kitp1.gif

There are four pages to the manual, differing only in the last character of the file name (before the ".gif" extension); p1, p2, p3, and p4. The schematic is on page 4 (p4).

The PIC program and PCB artwork are available free from the *Nuts & Volts* web site, www.nutsvolts.com. The files are bundled into STOPW.ZIP. If you wish to have the PCB professionally fabricated, a fast, low-cost source is AP Circuits. Visit their web site at www.apcircuits.com to download the necessary order form and instructions. You will find all of the tooling files for the order in a folder (directory) called PCB within the STOPW.ZIP file. **NV**

Program Listing

```
; ================================================================
; Program: STOPW.SRC (Stopwatch adapter for Jameco JE725 digital clock)
; ================================================================
; Written in the Parallax dialect of PIC assembly language
; by Scott Edwards, January 1998
; Revision: 0
; Compatibility: PASM, SPASM
; ================================================================
;   This program lets a PIC '55 (with some external level-shifting
; circuitry) serve as a replacement for the MM5314N digital clock
; chip used in the JE725 large-character digital clock. The PIC,
; clocked at 3.2768 MHz, turns the clock into a stopwatch capable
; of timing events up to one hour in duration to a resolution of
; 1/100th of a second. Accuracy depends on the clock crystal, but
; should be in the neighborhood of +/-100 ppm; an error of not more
; than 0.4 seconds per hour.
;   Most of the program is dedicated to maintaining the LED display.
; See the accompanying article for a schematic. The seven LED segments
; are controlled by port RB, where a 0 output produces a lit segment
; and a 1 is a dark segment. A table correlates the numbers 0-9 to the
; appropriate pattern of segments. The common connections for the
; display digits are connected to six bits of port RC, where a 1
; turns on a digit, and a 0 turns it off.
;   The stopwatch timing is based on a 1600-Hz clock derived from
; the 3.2768-MHz crystal using the PIC's built-in RTCC (prescaler/
; counter, called TMR0 in more recent PIC literature). The program
; displays one LCD digit every 1/1600th of a second. When it's
; counting (stopwatch triggered) it increments the count every
; 16 clocks, resulting in 1/100th-second resolution.
;   The user interface consists of just the three buttons already
; present on the JE725 clock. The new functions are CLEAR, GO, and
; STOP. These are connected to port RA. The remaining port RA bit
; is reserved for a serial input, which is not implemented in this
; project.
;   A word about optimization: This program was written to (1)
; produce a useful gadget, and (2) to show how easily PICs can be
; used in this role. Therefore, whenever ease of programming or
; clarity conflicted with efficiency, ease and clarity were
; automatic winners. Since the program easily fits into the
; least-expensive PIC with the required number of I/Os, there's
; no reason to optimize (except as a learning exercise).
;
================================================================
=

; Device data and reset vector
      device  pic16c55,xt_osc,wdt_off,protect_off
      reset   start

; Place variables above special-function registers.
          org       8
test   ds     1
digit  ds     1
clkChk ds     1         ; Workspace to check RTCC status.
goFlag ds     1         ; Start/stop status of stopwatch.

bcdDigs =     010h      ; Start address of BCD digits, 100ths — minutes.
clrBtn  =     ra.0      ; Button to clear the stopwatch count.
startBtn =    ra.1      ; Button to start the count.
stopBtn =     ra.2      ; Button to stop the count.

; Begin program at EEPROM address 0.
      org     0

; Table to match a pattern of LED segments to a given number (0-9).
; Segments are arranged g,f,e,b,c,d,a,x, where g goes to rb7 and x
; (not used) goes to rb0. The letters refer to standard seven-segment
; display notation, where 'a' is the top horizontal segment; b-f
; go clockwise around the display; and 'g' is the middle crossbar.
LEDsegs
      jmp     pc+w
      retw    10000000b,11100110b,01001000b,01100000b,00100110b
      retw    00110000b,00010000b,11100100b,00000000b,00100100b

; Table to match a single bit of port RC to a given digit number,
; where 0 is the 100ths, 1 is 10ths, 2 is seconds, etc.
LEDdigs
      jmp     pc+w
      retw    64,128,4,8,16,32

start
      call    clrBCD            ; Clear memory for digits.
      mov     rb,#255           ; Blank all segments.
      mov     !rb, #0           ; Make RB output to segments.
      clr     rc
      mov     !rc,#0
      mov     !ra,#1111b        ; Make RA all inputs.
      clr     test              ; Clear key variables.
      clr     digit
      clr     clkChk
      clr     goFlag
      call    clrBCD            ; Clear BCD counter.
      mov     w,#00000111b      ; Set RTCC to int clock/256.
      option                    ; Load w into option register.

scanDisplay
      sb      clrBtn            ; If clear-button is pressed,
      call    clrBCD            ; then clear BCD digits.
      clr     digit             ; Point to first digit of display.
      mov     fsr,#bcdDigs
:loop
      mov     rb,#255           ; Blank the display while changing
      mov     w,digit           ; from one digit to the next (prevents
      call    LEDdigs           ; "ghosting" of the display). Get
      mov     rc,w              ; digit-select bit-pat from LEDdigs and
      mov     w,indirect        ; write it to RC. Copy current digit
      call    LEDsegs           ; value into w and look-up segment
      mov     rb,w              ; pattern from LEDsegs. Write that
      inc     digit             ; to RB. Increment digit to point
      inc     fsr               ; to next BCD digit via fsr. After
      cjbe    digit,#5,:loop    ; scanning digits 0-5, check start,
      sb      startBtn          ; stop buttons and set or clear
      setb    goFlag.0          ; the "go" flag (flag that makes BCD
      sb      stopBtn           ; count increment).
      clrb    goFlag.0
      mov     test,RTCC         ; Now check to see whether bit 5 of
      XOR     w,clkChk          ; RTCC has changed since last visit.
      AND     w,#32             ; If it has, 1/100th of a second has
      jz      scanDisplay       ; elsapsed, so the BCD count should
      mov     clkChk,test       ; be incremented — but only if the
      snb     goFlag.0          ; "go" flag is set (1). When done,
      jmp     incBCD            ; go back to scanning the LED
      jmp     scanDisplay       ; display.

; ==incBCD==
; This sub adds 1 to the 100ths digit. If the result exceeds 9, it
; carries the 1 into the 10ths digit. If that exceeds 9, it carries
; on up the line. Note that seconds/10s and minutes/10s roll over
; at 5(9); e.g., 59.99 seconds becomes 00.00 seconds, adding 1 to
; minutes.
incBCD  mov     fsr,#bcdDigs    ; Point to 100ths.
        inc     indirect        ; Add 1.
        cjbe    indirect,#9,:done ; Less than 10 = no carry,
        clr     indirect        ; else carry 1 to next digit.
        inc     fsr             ; Point to 10ths.
        inc     indirect        ; ... and so on:
        cjbe    indirect,#9,:done ; Same process is done on
        clr     indirect        ; each of the six digits.
        inc     fsr             ; If program space were an issue,
        inc     indirect        ; this code could be made into
        cjbe    indirect,#9,:done ; a loop that walked through
        clr     indirect        ; each of the digit addresses
        inc     fsr             ; just like clrBCD. The only
        inc     indirect        ; difference would be that
        cjbe    indirect,#5,:done ; two of the digits — seconds/10s
        clr     indirect        ; and minutes/10s roll over at
        inc     fsr             ; 5 (as in 59 seconds or minutes)
        inc     indirect        ; so this would have to be handled.
        cjbe    indirect,#9,:done ; However, in this very small
        clr     indirect        ; program, space is not critical
        inc     fsr             ; at all, so we allow the luxury
        inc     indirect        ; of copy-and-paste programming.
        cjbe    indirect,#5,:done ; Note that we roll minutes at
        clr     indirect        ; 59, not 99, to allow manual
:done   jmp     scanDisplay     ; tracking of hours, if needed.

clrBCD  mov     fsr,#bcdDigs    ; Point to base of digits.
:loop   clr     indirect        ; Clear digit.
        inc     fsr             ; Point to next digit.
        cja     fsr,#224,:loop  ; Continue till fsr points to 0.
        ret
```

Write in 219 on Reader Service Card.

TEST EQUIPMENT *cont.*

TEK-SALE: New factory boxed CFC 250 timer/counter $125; new handheld DMM/counter $75, factory packaged 5 available; new factory boxed programmable DMM, DM 2510, 4.5 digits $300; RTD 710 digitizer $450; 475W DMM44, $400; MI-5010 program. multifunction interface $200; 7A13 $135; 7A16P $75; 7A17 $40; 7A18 $50; 7A22 $175; 7A24 $125; 7A26 $62; 7B53A $58; 7B80 $70; 7B85 $75; 7B87 $125; 7B92A $125; 7D12 $100; 7D13 $100; 7D15 $250; **7D20 programmable digitizer** $300; DL-502 latch $50; DD-501 $85; DM-501 multimeter $100; P-6202A probe $200; 7S11 $150; 7S12 $300; S-52 $150; S-53 new $400; SI-5010 $350; all with 30 day warranty; call **Psitech Plus** 707-745-4804 request bi-monthly fax listings Fax 707-747-5277, E-Mail: apeas@ix.netcom.com

LOWEST PRICES! Check out Metric's "Bargain Basement" at http://www.metricsales.com Most items under $125!

EQUIPMENT SALE: 8620C all scales $500 w/86290A $900; HP 3775A opt. 01 phase gain meter $500 without option $350; 36037A repeater $75; 37203A HP-IB extender $65; 59308 timing generator $50; 59501A power supply programmer (as new) $60; 5420A w/10920A digital signal analyzer $200; HP 141T $275; late model 8170A logic pattern generator $175; 8470A opt. 02 network analyzer $250; 8742A reflection test set $200; 1630D logic analyzer with acc. $250; HP 18653B sample event control module $75, 5 available. **Psitech Plus** 707-745-4804 request twice-monthly fax listings. Fax 707-747-5277. E-mail: apeas@ix.netcom.com

TEST EQUIPMENT for sale/wanted: RF, Microwave, video and fiber optic. Broadcast TV, satellite and related industries. Wavetek, Tektronix, Hewlett Packard and other manufacturers. Spectrum analyzers, signal level meters, sweep systems, TDRs, OTDRs, and much more. PTL Cable Service. Phone 561-747-3647 FAX 561-575-4635.

POWER SUPPLY SALE: HP 6112A 40V 5A $125; HP 6253A DUAL 20V 3A $275; HP 6271B 60V 3A $375; HP 6434B 40V 25A $375; HP 6260B 10V 100A $325; HP 6264B 20V 20A $250; HP 6265B 40V 3A $225; HP 6266A 40V 6A $225; HP 6282A 10V 10A $225; HP 6403B 7.5V 3A $150. AST GLOBAL ELECTRONICS. Voice: 1-888-216-7159; Fax: 814-398-1176; E-Mail: astmrktg@toolcity.net

HP 8601A sweeper .4-110MHz, $350; Wavetek 3002-673 AM FM sig. gen. 1KHz-530MHz, $850; Wavetek 3007, sig. gen. 1KHz-530MHz AM FM modulation meter, $900; HP 204C audio gen., $150, HP 209A sine squarewave osc., $150; HP 3400A, true RMS meter, $250; HP 334A distortion meter, $500; HP 428B, current meter and probe, $300; HP 6111A precision power supply 0-20V 0-1A, $200; Lambda LQ532-40141 power supply 0-40V 5 amp CVCC dig. readout, $250; Keithley 614 electrometer, $800; A-Comm Electronics 303-290-8012.

QUALITY TEST EQUIPMENT: HP 3488A switch/control mainframe $850 (cards available). **HP 59306A** relay actuator (6-SPDT) $200. **HP 59307A** dual VHF switch (2-SP4T) $200. **HP 8161A/020** 100MHz HP-IB dual channel pulse generator $3,100. **HP 5334A** 100MHz counter (rise/fall time, HP-IB, etc.) $850. **HP 5335A/20,40** 200MHz counter (rise/fall time, statistics, HP-IB, etc.) $1,200. **Stanford Research SR 510** lock-in amplifier $1,400. **HP 339A** distortion analyzer $1,600. **Tek 222A** handheld battery-operated digital storage scope $1,250 (many accessories available). **HP 11869A** adapter (for 8350B) $350. **HP 8502A/H26** transmission/reflection test set $950. **HP 8748A/H26** S-parameter test set $1,550. **HP 436A/022, 8481A** RF power meter, sensor $1,775. Excellent condition! All with warranty. Pepper Systems, 214-353-0257 (FAX 214-902-9511).

WANTED: USED TEST EQUIPMENT. CONTACT: AST GLOBAL ELECTRONICS, 24529 State Highway 408, Cambridge Springs, PA 16403. Voice: 1-888-216-7159; Fax: 814-398-1176; E-Mail: astmrktg@toolcity.net

OSCILLOSCOPE SALE: TEK 335 (35MHz) $275; 464 (100MHz STORAGE) $375; 465 (100MHz) $375; 465B (100MHz) $450; 466 (100MHz STORAGE) $475; 475 (200MHz) $475; 475A (250MHz) $650; 7704A (250MHz MAINFRAME) $175; 2213 (100MHz) $375; 2215 (60MHz) $325; 2215A $350; 2335 (100MHz) $650; 2335 (100MHz) NEW IN BOX COMPLETE $975; 2445 (150MHz 4 CHANNEL) $1,600; AST GLOBAL ELECTRONICS. Voice: 1-888-216-7159; Fax: 814-398-1176; E-Mail: astmrktg@toolcity.net

Write in 63 on Reader Service Card.

Events

CALENDAR

The Events Calendar is a free service limited to electronic events such as computer shows, hamfests, flea markets, etc. If your organization is sponsoring an event and would like a free listing, contact us at least 60 days prior to the event. Include your flyer, estimated attendance, name of the person to contact, and phone number.

Complimentary issues are available upon request for distribution to your attendees. A street address for UPS is required.

While we strive for accuracy in our calendar, we can not be responsible for errors or cancellations. The information contained in this column is for the use of the readers of *Nuts & Volts* and may not be republished in any form without the written permission of T & L Publications, Inc.

All listing information should be sent to:
Nuts & Volts Magazine
Events Calendar
430 Princeland Court
Corona, CA 91719
Phone 909-371-8497
Fax 909-371-3052
E-mail events@nutsvolts.com

FEBRUARY 1998

FEBRUARY 1

CA - LIVERMORE - Swapmeet. Las Positas College. Noel Anklam 510-447-3857
ME- PORTLAND - Computer Show. Verrillo's. Northern Computer Shows 978-744-8440
MI - GRAND RAPIDS - Super Computer Sales. Crowne Plaza, 5700 28th St. 10am-4pm. Computers And You, 313-283-1754
NY - ROCHESTER - Computer Show. The Dome Center. 9:30am-4pm. MarketPro 201-825-2229. http://www.marketpro.com
OH - CLEVELAND - Computer Show. Cuyahoga Co. Fairgrounds. 10am-3pm. Peter Trapp Shows, 603-272-5008. www.petertrapp.com

FEBRUARY 2

AZ - SUN CITY - Amateur radio equipment auction. St. Clement Social Hall, 15800 Del Webb Blvd. 7pm. George N7JSA, 602-933-0854. E-Mail: watgl@juno.com

FEBRUARY 6-7-8

IL - PEORIA - Super Computer Sale. Peoria Civic Center. 201 S.W. Jefferson St. Blue Star Productions 612-788-1901. Web: http://www.supercomputersale.com
MI - TAYLOR - Computer & Technology Show. Gibraltar Trade Center, 15525 Racho Rd. 313-287-2000

FEBRUARY 7

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
NY - ALBANY - Computer Show. Polish Community Center. 9:30am-4pm. MarketPro 201-825-2229. http://www.marketpro.com
SC - NORTH CHARLESTON - ARS Hamfest. Jenny Myers WA4NGV, 803-747-2324. E-Mail: WA4USN@amsat.org

FEBRUARY 7-8

FL - MIAMI - Hamboree. Dade Co. Fair & Expo Center, SW 112th Ave. & Coral Way. Evelyn 305-642-4139. E-Mail: edg@elink.net Web: http:// hamboree.org
MO - ST. CHARLES - Computer Show & Sale. St. Charles Exposition Hall, St. Charles Center, I-70 & 5th St. Sat: 10am-4pm, Sun: 11am-3pm. Computer Central Shows 888-296-6066. E-Mail: computershow.chicago@mcimail.com
MS - JACKSON - State Convention. Ron Brown AB5WF, 601-956-1448. 601-982-0101. E-Mail: ab5wf@juno.com
NJ - SECAUCUS - Computer Show. The Meadowlands Expo Center. 9:30am-4pm. MarketPro 201-825-2229. http://www.marketpro.com
NY - SYRACUSE - Computer Show. State Frgnds., Int'l Bldg. Sat: 10am-5pm, Sun: 10am-3pm. Peter Trapp Shows, 603-272-5008. www.petertrapp.com

FEBRUARY 8

MA - TAUNTON - Computer Show. Holiday Inn. Northern Computer Shows 978-744-8440
MA - WEST SPRINGFIELD - Computer Show. Eastern States Exposition. 9:30am-4pm. MarketPro 201-825-2229. http://www.marketpro.com
OH - MANSFIELD - Mid Winter hamfest. Richland Co. Fairgrounds. Pat Ackerman N8YOB, 419-589-7133 eves.
PA - LATROBE - Hamfest & computer show. American Legion, 1811 Ligonier St. 8am-3pm. Andrew Michalovicz KE3YU, 412-539-0468. Chris Weiss K3JDU, 412-537-6068

FEBRUARY 13-14-15

FL- ORLANDO - HamCation & Computer Show. Central FL Fairgrounds. 4603 W. Colonial Dr. Fri: 5pm-9pm. Sat: 9am-5pm. Sun: 9am-3pm. Web: http://www.oarc.org E-Mail: ae4nj@aol.com
IN - INDIANAPOLIS - IN Convention RCA Dome. 100 S. Capital. Blue Star Productions 612-788-1901. Web: http://www.supercomputersale.com

FEBRUARY 14-15

SC - GREENVILLE - Computer Show. Palmetto Expo Center. 9:30am-4pm. MarketPro 201-825-2229. http://www.marketpro.com

FEBRUARY 14

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves
MA - MARLBOROUGH - Flea Market. Middle School. 10am-2pm. Ann Weldon 508-481-4988
MN - BLAINE - Ham and computer show. National Sports Center. 7:30am-3pm. Susan Baker N0JND, 612-537-1722
NY - BROOKVILLE - Computer Show. C. W. Post College. 9:30am-4pm. MarketPro 201-825-2229. http://www.marketpro.com
NY - WESTFIELD - CCRA Hamfest & Computerfest. Westfield Academy & Central School. Rte. 20-E. Main St. 8am-3pm. Eric Kroon 716-595-2646. E-Mail: ekroon@netsync.net
PA - OBERLIN - Winter Hamfest. Oberlin Fire Co., Fire Hall. HRAC 717-232-6087. fabinfo@fabral.com

FEBRUARY 15

CO - BRIGHTON - Aurora Repeater Assn. Hamfest. Wayne Heinen N0POH, 303-699-6335. E-Mail: nrclog@aol.com
IL - ROCK ISLAND - Hamfest & Computer Show. QCCA Expo Center, 2621 4th Ave. Kent Williams K9UQI, 309-796-0718. E-Mail: k9uqi@arcsupport.com Web: http://www.arcsupport.com/drac
MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988

FEBRUARY 15-16

NY - LAKE GROVE - Computer Show. Sports Plus. 9:30am-4pm. MarketPro 201-825-2229. http://www.marketpro.com

FEBRUARY 20-21-22

KS - KANSAS CITY - Super Computer Sale. Overland Park Trade Ctr. 6800 W. 115th St. Blue Star Productions. 612-788-1901. Web: http://www.supercomputersale.com

FEBRUARY 21

AR - RUSSELLVILLE - AR River Valley Foundation Hamfest. Dallas Scott KD4TNQ, 501-967-3317. E-Mail: dscott@cswnet.com Web: http://www.noon er.com/arvarf
CA - MONTEREY - Winterfest. Monterey Peninsula College Armory. 8am-2pm. Bev McKinney, 408-663-6117. http://www.mcktech.com/wf98.htm
CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
CANADA - ONTARIO - BURLINGTON - ARC Hamfest. Hugh McCully VE3AYR, 905-333-0826. E-Mail: chuck.wilson@sympatico.ca
NC - ELKIN - Briarpatch and Foothills ARCs Hamfest. Jimmy Holbrook KB4GKI, 910-957-3820. E-Mail: jholbro363@aol.com
NJ - PARK RIDGE - Computer Show. Park Ridge Marriott. 9:30am-4pm. MarketPro 201-825-2229. http://www.marketpro.com
NY - BUFFALO - Computer Show. Hamburg Fairgrounds. 9:30am-4pm. MarketPro 201-825-2229. http://www.marketpro.com
OR - RICKREALL - Hamfair. Polk Co. Fairgrounds. 9am-3:30pm. Evan Burroughs N7IFJ, 503-585-5924. http://www.teleport.com/~n7ifj/sraflyer.htm

FEBRUARY 21-22

IN - INDIANAPOLIS - AGI Computer Fair. National Guard Armory, 3912 W. Minnesota. 10am-5pm. 317-299-8827. E-Mail: agi@surf-ici.com Web: http://www.surf-ici.com/agi
FL - SARASOTA - ARA Hamfest. Dave Armbrust AE4MR, 941-923-3967 or 941-922-8857. E-Mail: ae4mr@ix.netcom.com
NY - WHITE PLAINS - Computer Show. Westchester County Center. 9:30am-4pm. MarketPro 201-825-2229. http://www.marketpro.com
OH - CINCINNATI - Great Lakes Div. Convention. Cincinnati Gardens Exhibition Center, 2250 Seymour Ave. 8:30am-5pm. Bill Tittle KA8LAY, 513-661-1805. E-Mail: BOBGARFIELD@JUNO.COM

FEBRUARY 22

IL - GLEN ELLYN - Computer Show & Sale. College of DuPage. Main Arena of Phys Ed Bldg. Corner of Park Blvd. & College Rd. 9:30am-3pm. Computer Central Shows 847-940-7547
MI - DEARBORN - Swap 'n Shop. Civic Center. 8am-3pm. Neil Coffin WA8GWL, 313-261-5486. Web: www.larc.mi.org E-Mail: wa8gwl@larc.mi.org
NJ - PARSIPPANY - Computer Show. Parsippany Hilton. 9:30am-4pm. MarketPro 201-825-2229. http://www.marketpro.com
NY - FREEPORT - ARC Hamfest. Richie Selzer, N2WJL 516-520-9311. E-Mail: n2wjl@juno.com
NY - ROCHESTER - Computer Show. The Dome Center. 9:30am-4pm. MarketPro 201-825-2229. http://www.marketpro.com
OH - CUYAHOGA FALLS - Hamfest. Emidio's Party Ctr., 48 Bath Rd. 8am-2pm. Dan Adkinson KC8CFJ, 330-923-9045. hamfest@neo.lrun.com
PA - CASTLE SHANNON - Hamfest & Computer Show. VFD Memorial Hall, Rte. 88. 8am-3pm. Steve Lane N3RNY, 412-341-1043. E-Mail: sharcfest@juno.com Web: http://www.hky.com/~sanfordb/index.htm
VA - VIENNA - Hamfest. Vienna Community Center, Park & Cherry St. Mike K3MT, 703-834-5000 xt 2729. http://www.erols.com/k3mt/vws
WV - FAYETTEVILLE - Plateau ARA Hamfest. Richard M. Roy KB8SMC, 304-469-3292, 304-465-1911

FEBRUARY 27-28- MARCH 1

CO - DENVER - Super Computer Sale. National Western Complex. 4655 Humboldt St. Blue Star Productions 612-788-1901. Web: http://www.supercomputersale.com
NV - RENO - Hamworld Int'l Conv. Reno/Sparks Conv. Center. 509-782-2079. E-Mail: D1234@NWI.NET

FEBRUARY 28

GA - DALTON - ARC Hamfest. Harold Jones N4BD, 706-673-2291
IN - LAPORTE - ARC Hamfest. Civic Center. John N9ROH, 219-326-7182 evenings.
KY - EDMONTON - Southern KY DX Association. Special Event. 3pm-9pm. Larry Brumett KN4N, 502-651-2363
NY - POUGHKEEPSIE - Computer Show. Mid-Hudson Civic Center. 9:30am-4pm. MarketPro 201-825-2229. http://www.marketpro.com
TX - ORANGE - ARC Hamfest. Joan Lexa WA5LFT, 409-886-1892. E-Mail: WA5LFS@pnx.com
VT - MILTON - Northern Vermont Winter Hamfest. Milton High School, Rte. 7. 8am-3pm. W1SJ, 802-879-6589. E-Mail: wb2jsj@vbi.champlain.edu

FEBRUARY 28-MARCH 1

NY - STONY BROOK - Computer Show. SUNY Stony Brook. 9:30am-4pm. MarketPro 201-825-2229. http://www.marketpro.com

MARCH 1998

MARCH 1

CA - LIVERMORE - Swapmeet. Las Positas College. Noel Anklam 510-447-3857
IL - PALATINE - Computer Show & Sale. Harper College. Bldg. M (Phys Ed Bldg.). Roselle & Algonquin Rds. 9:30am-3pm. Computer Central Shows 847-940-7547
NY - SYRACUSE - Computer Show. Four Point Hotel. 9:30am-4pm. MarketPro 201-825-2229. http://www.marketpro.com

MARCH 6-7-8

MI - MT. CLEMENS - Computer & Technology Show. Gibraltar Trade Center, 237 N. River Rd. 810-465-6440
NE - NORFOLK - Nebraska State Convention. Fred Wiebelhaus N0VLX. 402-379-1929

MARCH 7-8

NC - CHARLOTTE - Mecklenburg ARS Hamfest. Charlotte Merchandise Mart, 2500 E. Independance Blvd. Tim Slay WO4G, 704-948-7373. http://www.w4bfb.org

MARCH 7

AL - TUSCALOOSA - Black Warrior Swapfest. Kelly Bruce WD4DAT, 205-339-7882. E-Mail: bwhamfest@juno.com Web: http://tusc.net/~rkbruce/waars_radio/
CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
FL - EAST ENGLEWOOD - HamCom. Tringali Community Ctr. 8am-3pm. George Shreve KA4JKY, 941-697-3445. E-Mail: gshreve@ewol.com
FL - NEW PORT RICHEY - Ridgewood Hamfest. Ridgewood High School, 7650 Orchid Lake Rd. Rick Brown 813-842-2127
IN - LAFAYETTE - AGI Computer Fair. Tippecanoe Co. Fairgrounds. 10am-4pm. 317-299-8827. E-Mail: agi@trader.com Web: http://www.surf-ici.com/agi
MI - ROSEVILLE - L'Anse Creuse ARC open house. Macomb Mall. Diane Scalzi WI8K, 810-296-6623. E-Mail: dms@match.org
NJ - ABSECON - Hamfest. Holy Spirit High School, Rte. 9. Eva Mangeri KB2QXU, 609-407-2923
NJ - PARSIPPANY - Split Rock ARA Hamfest. Mark Turner KB2VKO, 973-347-3195. E-Mail: mlturner@bellatlantic.net Web: http://home.hsix.com/sara/hamfest.html
WA - PUYALLUP - Electronics Show & Flea Market. W. WA Fairgrounds, Pavilion Exhibition Hall. E-Mail: mwdink@eskimo.com Information 253-631-3756 6pm-9pm PST

MARCH 8

IN - INDIANAPOLIS - Morgan Co. Repeater Assn. Hamfest & Computer Show. State Fairgrounds. Dennis Baurenfiend WB9ZNZ 317-996-3782. E-Mail: dbauernfiend@cleveland.Dfas.mil
NY - LINDENHURST - Hamfest. Walter Wenzel KA2RGI, 516-457-0218. E-Mail: Tom Carrubba: ka2d@li.net Web: http://www.li.net/~tom car/hamfest.htm
OH - CONNEAUT - ARC Hamfest & Computerfest. Human Resource Center, 327 Mill St. Clarence Baugher W8FAS, 216-593-3038
WI - WAUKESHA - Hamfest and Computer Expo. Co. Expo Center, N1W24848 Northview Rd. 8am-2pm. Mary J. Adams KB9IFF, 414-358-1003. E-Mail: mjadams@execpc.com

MARCH 13-14

OK - TULSA - Hamfest. Maxwell Convention Ctr. 700 S. Houston Ave. 918-622-2277. E-Mail: megrif fin@ionet.net Web: www.greencountry.cohamfest

MARCH 13-14-15

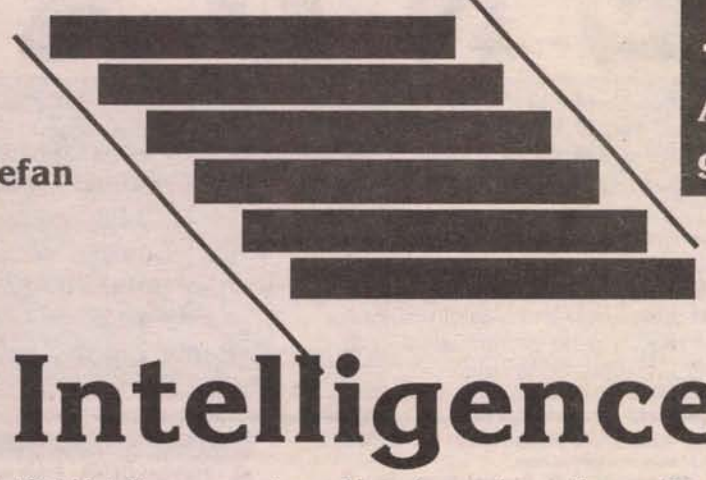
MI - TAYLOR - Computer & Technology Show. Gibraltar Trade Center, 15525 Racho Rd. 313-287-2000
NE - OMAHA - Super Computer Sale. Omaha Civic Auditorium. 1804 Capital Ave. Blue Star Productions 612-788-1901. Web: http://www.supercomputersale.com

MARCH 14

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves
FL - SEBRING - Highlands Co. ARC Hamfest. Dennis Koranda KF4JTM. 941-382-9560. E-Mail: kf40strato.net Web: http://www.strato.net/~hamradio/
IN - GREENFIELD - AGI Computer Fair. Hancock Co. Fairgrounds. 10am-4pm. 317-299-8827. E-Mail: agi@trader.com Web: http://www.surf-ici.com/agi
MI - MARSHALL - ARC Hamfest. Marshall High School. 8am-3pm. Wes Chaney N8BDM, 616-979-3433
MO - KANSAS CITY - Ararat Shrine ARC Hambash. Ararat Temple, 5100 Ararat Dr. 8am-2pm. Steve Dowdy WJ0I, 816-941-3392. E-Mail:

Continued on page 93

First Steps in Artificial Intelligence



by Jeff Stefan

If you're interested in artificial intelligence but don't know where to start, this is the place to be. This article introduces you to Artificial Intelligence and shows you where to get the tools on the World Wide Web, *for free*!

What is Artificial Intelligence, or AI? Pick up any two books on the subject and you won't find the same definition. Read the sidebar "Definitions of Artificial Intelligence" for a collection of AI definitions.

Once you work in AI for a while, you'll come up with your own definition. If I had to define what AI is, I'd say "Artificial intelligence is the art of creating consciousness in a machine."

AI encompasses many fields, such as computer science, engineering, linguistics, psychology, and biology. That's what makes it interesting, but hard to define. AI is an introspective science, where many answers to deep questions in artificial intelligence lie within yourself.

When you determine a course of action to take in any given circumstance, how do you decide what to do? If you're solving a programming or circuit design problem, doing a crossword puzzle, or simply deciding what to have for lunch, what is the mental process you go through? Think about how you would implement this process in a machine.

The term artificial intelligence is relative: what were once considered AI applications (word processors, spelling, and grammar checkers) are now commonplace. Artificial intelligence tools and applications eventually move out of the AI domain once they are fully understood and developed. Most find their way into the commercial mainstream.

Vision systems and pattern recognition software are now used fairly routinely in manufacturing systems, where they once were found only in university research laboratories. Speech recognition software is rapidly moving out of the AI labs and into the everyday working world.

How do you know if an entity is artificially intelligent? Alan Turing was concerned with this, way back in the 1930s. Alan Turing is generally acknowledged as the father of modern computer science, and the inventor of the theoretical construct called the Turing Machine (see the July '97 issue of *Nuts & Volts* for an article describing Turing Machines).

Turing outlined what has come to be known as the Turing Test. This test, simple in execution, consists of a human sitting at a terminal carrying on a conversation with another human being and a machine networked to other terminals. The human doesn't know whether he or she is talking to another person or a machine. If the human comes away from the conversation unable to differentiate between the machine and the other person, then the machine is indeed acting in an intelligent manner.

This test seems non-rigorous and subjective, but so far no one has successfully created a machine that passes the Turing Test. The concept of the Turing Test was presented in Turing's paper *Computing Machinery and Intelligence*. The publication of this paper in 1950 marks the pre-dawn of artificial intelligence.

If 1950 was the pre-dawn of AI, then the sun fully emerged over the horizon in 1956. This was the year of the Dartmouth Conference, organized by John McCarthy and Marvin Minsky. The Dartmouth Conference was proposed to be "a two-month, 10-man study of artificial intelligence." AI folklore claims that this is where the term "artificial intelligence" was first used.

LISP and Prolog

Two main languages are used for AI research, LISP and Prolog. LISP, which stands for List Processor, was developed by John McCarthy in 1958. LISP is still the primary language used for AI research. Prolog was created by Alain Colmerauer at the University of Aix-Marseille in France. The original incarnation of Prolog created by Colmerauer is referred to as the Marseille syntax.

Prolog started to rise in popularity when the book *Programming in Prolog* became available. *Programming in Prolog* was written by William Clocksin and Christopher Mellish while they were working at the University of Edinburgh. The version of Prolog they describe is called the Edinburgh syntax, which has become the de-facto Prolog standard, superseding the Marseille version.

It's a true testament to the power and quality of LISP that it's not only survived for 40 years, but is still the premier language of choice for AI research. LISP is designed for symbol processing, so it's a natural for symbolic programming.

LISP is a loosely structured language, and loosely specified. The consequence of this lack of structure is the emergence of several different LISP dialects, such as MACLISP and INTERLISP. Fortunately, a kind-of standard has emerged as COMMON LISP. Most textbooks and on-line tutorials use COMMON LISP for their programming examples.

An implementation of LISP that I like to use is XLISP. XLISP was written by David Betz and is about 10 years old. XLISP is a DOS application and all the source code is readily available. XLISP is written in C and compiles fairly easily on any C compiler. The XLISP executable program is fairly small (145K) and should be adaptable to embedded systems or small robots. I'm willing to give up a nice Windows interface for that level of portability.

Having access to the source code allows you to expand and tailor XLISP to your personal needs. If you're interested in adding new primitives to XLISP and need some advice, visit the web site Programmer Docs for SLISP at http://www5.biostr.washington.edu/slisp/slisp_toc.html#SEC59. This site also contains an XLISP tutorial and an XLISP language reference. As far as free languages go, the documentation available for XLISP is unparalleled. You can download a copy of XLISP at http://www.idiom.com/free-compilers/TOOL/lisp-2.html.

A free Windows95 version of LISP is Harlequin FreeLisp. I've used Version 1.0.2 patch level 12 without any noticeable problems. FreeLisp, a COMMON LISP implementation, runs on a PC with at least eight megabytes of memory. All you need to do to get a copy of FreeLisp is to download it from Harlequin's web site and fill out a small questionnaire. There is also an on-line manual available.

All the instructions you need to get FreeLisp running on your machine are given at Harlequin's site. I had no trouble at all downloading and installing FreeLisp

An implementation of Prolog that I like is ADA Public Domain Prolog, or PD Prolog. You can get PD Prolog at the Engineering Software Database by downloading the self-extracting zip file PRLG195A.EXE. The sparse documentation suggests using Clocksin and Mellish's *Programming in Prolog* as a user's manual.

ADA Prolog is also about 10 years old, and

Definitions of Artificial Intelligence

Artificial intelligence is the study of mental faculties through the use of computational models. [1]

Artificial intelligence is the study of the computation that makes it possible to perceive, reason, and act. [2]

Artificial Intelligence (AI) is our effort to give machines intelligence like humans. [3]

Artificial intelligence - the search for ways to program computers so that they might come to behave with flexibility, common sense, insight, creativity, self-awareness, humor, and so on. [4]

Artificial intelligence is exactly what its name implies: the attemp to build intelligent artifacts. [5]

[1] Charniak and McDermott, Introduction to Artificial Intelligence

[2] Winston, Artificial Intelligence Third Edition

[3] Narayanan, Sharkey An Introduction to Lisp

[4] Hofstadter, Metamagical Themas: Questing for the Essence of Mind and Pattern

[5] Covington, Nute, Vellino, Prolog Programming in Depth

AI Websites

Brighton University Resource Kit for Students (BURKS)
http://burks.bton.ac.uk/burks/index/htm

Paradigms of Artificial Intelligence Programming
http://www.norvig.com/paip.html

Marvin Minsky's Home Page
http://www.ai.mit.edu/people/minsky/minsky.html

Engineering Software Database
http://www.mecheng.asme.org/database/AI/MASTER.HTML

XLISP
http://www/idiom.com/free-compilers/TOOL/lisp-2.html

AI Programming Resources
http://www.cs.berkeley.edu/~russell/prog/html

Lisp Resources
http://www.eecs.harvard.edu/onlisp/

John McCarthy's Home page
http://www-formal.stanford.edu/jmc/

Harlequin FreeLisp
http://www.harlequin.com/products/ads/freelisp/

Programmer Docs for SLISP
http://www5.biostr.washington.edu/slisp/slisp_toc.html#SEC59

Fig. 1

LISP Titles

LISP Second Edition by Henry Patrick Winston and Berthold Paul Horn
Addison Wesley Reading, MA.

This is probably the best place to start with LISP if you have some programming experience. The pace is moderate, the concepts are well explained, and there are answers to the exercises.

The Little LISPer by Daniel Friedman and Matthias Felleisen
Now called the Little Schemer and a companion volume called The Seasoned Schemer, both available from the MIT Press.

The Little LISPer is a classic, practical book on LISP written a "programmed learning" style. The format of the book conveys the maximum amount of information in the shortest amount of space without sacrificing understandibility.

Paradigms of Artificial Intelligence Programming: Case Studies in Common Lisp by Peter Norvig
Morgan Kaufmann Publishers, San Mateo, CA

This book assumes that you can already program in LISP, so it's pace is fairly advanced. It exposes you to some of the classic AI programs written in LISP and provides answers to exercises. A unique feature of the book is how it ranks in difficulty the exercises, from Simple (which should take seconds to program and solve) to Difficult (which may take days). At least it lets you know what you're getting into before you tackle one of the exercises. It explores in detail some of the classic AI programs such as GPS (General Problem Solver), ELIZA, and MACSYMA.

An Introduction to LISP by A. Narayan and N.E. Sharkey
Ellis Horwood Limited West Sussex, England

This is a gentle and entertaining introduction to LISP. It's part of the well written Ellis Horwood series in Artificial Intelligence. There is an undercurrent of subtle British humor throughout as you construct two robots "Ann Droid" and "Roy Butt". There are even references to the the old Eric Clapton band, Cream.

The Elements of Artificial Intelligence Using Common LISP by Steven Tanimoto
Computer Science Press, New York, NY

This book is a little advanced, but has a lot of useful LISP procedures you can use in your own applications.

Fig. 2

was created by Automata Design Associates. Automata Design Associates is out of business, but ADA Prolog still persists on the web. I like it because it's small and easy to use.

Why use LISP or Prolog? Let's say that you had to perform an operation on someone. You had two choices of tools: a Swiss Army knife that had a wide, blunt blade, or a precisely engineered scalpel that was designed for the job. For AI applications, LISP is that scalpel.

If you're building an expert system or doing some work in First Order Logic, you can take advantage of Prolog's built-in inference engine, but LISP is still the best AI programming tool available.

You could write an AI application in C/C++, Pascal, or even assembly language, but these tools are general-purpose and are not specifically designed to investigate AI problems. LISP is.

If you need to create a system based on First Order Logic or can take advantage of a built-in inference engine, Prolog is the logical choice.

Artificial Intelligence programming and research is not limited to LISP, Prolog, and symbolic processing. Many other exciting areas and side-roads exist, including Neural Networks, Fuzzy Logic, and Genetic Algorithms.

Neural Networks

There have traditionally been two outlooks on AI: the connectionist view and the symbolic view. First Order Logic, and the representation of rule-based knowledge fall in the symbolic processing camp, while neural networks fall into the connectionist camp.

Neural networks, or artificial neural systems, are mathematical models of biological neural systems implemented in a machine. The concept of artificial neural systems (ANS) have been around since the 1940s, but only within the last 10 years have they gained popularity.

This trend in the expansion on ANS research mysteriously coincides with the proliferation of low-cost, powerful computer systems, AKA the PC. ANS research will probably take another giant step when and if parallel machines become a commodity.

Neural network research combines three disciplines; computer science, neurological sciences, and cognitive sciences. Neural networks essentially work from the bottom up. Inputs are detected and fed back to several layers of neurons until a pattern emerges. The pattern is remembered and can be compared to other patterns. If the patterns are similar, then other neurons fire in recognition of the pattern. The input patterns do not have to be identical, only similar, and that's the real power of neural networks.

A classic neural network application is handwriting recognition. Not many people write the same way. Neural networks can learn, in general, what an "a" looks like, what a "b" looks like, and so on. When a pattern is input that looks somewhat like the general model of an "a" that the neural network has learned, then the network fires and the "a" is recognized.

Fuzzy Logic

Fuzzy Logic was invented by Lofti Zadeh in 1964. Fuzzy logic centers around the border of objects. Divisions between objects are not necessarily cleanly defined, such as set membership. In traditional set theory, an object is a member of a set, or it's not. The object's truth value is one if it is a member of a set, and zero otherwise.

Fuzzy logic "fuzzifies" the borders, making them less precise. Truth values are separated into two classes: crisp and fuzzy. The crisp values are yes and no or one and zero. The fuzzy values are generally represented by a real number attaching a kind of weight to indicate which set an object belongs to. The weight value indicates the degree of truth of the object's set membership. This models real phenomena quite well; few things in the world are black and white, one and zero, true or false.

Fuzzy logic was originally rejected in the United States, but embraced in Japan. Fuzzy logic systems are embedded in Japanese consumer products ranging from cameras to washing machines.

Genetic Algorithms

What happens to a biological organism over time? It either dies out or survives. If the organism survives, its species evolves and becomes more fit to deal successfully with its environment. This is called survival of the fittest. Genetic Algorithms follow this model.

To construct a genetic algorithm, you first create a set of strings called a population. The set of strings in a population are called individuals, and the bits or characters that make up the individuals are called chromosomes. The individuals are passed through a "fitness" function, and if the individual passes, then it is allowed to recombine with other individuals. If it fails the fitness function, then it is discarded.

Occasionally individuals are mutated. One or two bits in an individual's chromosome string are complemented (one becomes a zero, and vice versa). Over time, individuals within a population evolve. If you're trying to solve a particular problem, such as a solution to an equation, a properly constructed genetic algorithm will evolve toward a solution to the equation. Traditionally, Lisp was for genetic algorithm research, but recently, C++ genetic class libraries are becoming popular and readily available.

If you're into Genetic Algorithms and Artificial Life, then you should

Prolog Titles

Programming in Prolog by W. F. Clocksin and C. S. Mellish.
Springer Verlag,, New York, NY

This book is to Prolog as The C Programming Language by Kerningham and Richie is to C. Programming in Prolog is the definitive reference for the Edinburg syntax of Prolog, which is the defacto standard.

Prolog Programming in Depth by Michael A. Covington, Donald Nute, and Andre Vellino
Scott, Foresman and Company, Glenview, Ill

This book is loaded with examples which have been tested on a variety of Prolog interpreters, including PD Prolog. Part I of the book concentrates on core Prolog programming, while Part II applies Prolog to a variety of AI problem and research areas. This book is loaded with code, and is written from a practicioner's viewpoint.

Prolog Programming for Artificial Intelligence by Ivan Bratko
Addison Wesley, New York, NY

This book is part of the International Computer Science Series from Addison Wesley. It's very textbook like and is more formal than the other Prolog books mentioned. This book is also split into two parts. Part I is a solid introduction to programming in Prolog, and Part II shows how to apply Prolog to a variety of AI problems. Selected exercises are answered, so that makes this book valuable.

Fig. 3

AI and Related Titles

Artificial Intelligence Third Edition by Henry Patrick Winston
Addison Wesley, Reading MA

This is an all encompasing book that has traditionally been one of the AI classics.

Introduction to Artificial Intelligence by Eugine Charniak and Drew McDermott
Addison Wesley, Reading MA

This book is focused, well written, and utilizes logic as a practical tool.

Neural Networks Algorithms, Applications, and Programming Techniques by James A. Freeman and David M. Skapura.
Addison Wesley, Reading MA

Although highly technical, this book is close to being a definitive reference and is loaded with C/Pascal-like pseudo code. If you want to deeply understand neural networks and learn how to implement them, this is the book to buy and study.

Preceptrons by Marvin Minsky and Seymour Papert
MIT Press, Cambridge, MA

This is pretty much where it all started as far as neural networks go.

Fuzzy Logic The Revolutionary Computer Technology That is Changing Our World by Daniel McNeill and Paul Freiberger
Touchstone, New York, NY

This is a non-technical book that's loaded with real-life history of the fuzzy logic creators and implementers. It contains just enough technical detail that gives the reader a solid understanding of fuzzy technology. This book is good place to start if you're interested in fuzzy logic and its far-reaching applications.

Fig 4

Rudy Rucker's Books

If you're interested in artificial life, genetic algorithms, and robot intelligence in general, then read Rudy Rucker's novels. Start with The Hacker and the Ants, then move on to the Bopper series, Software, Wetware, and Freeware. These are fresh, imaginative books that shouldn't be missed. Rudy Rucker, a math professor at San Jose State University, also maintains a web site where you can download free artificial life software. Check it out!

There are deep currents of theoretical computer science, Godel's Incompleteness Theorem, and evolutionary programming underlying Rucker's plot lines. Rucker's books are simply the best on these subjects, bar none.

You can visit Rucker's web site at: http://www.mathcs.sjsu.edu/faculty/rucker

check out Rudy Rucker's books and software. Apart from the depth of intellect and science in his books, they're entertaining and fun to read! See the sidebar "Rudy Rucker's Books" for more information.

Symbolic Processing and First Order Logic

Most traditional AI applications written in LISP or Prolog involve symbolic processing and a lot of First Order Logic. Having a good handle on First Order Logic is important if you want your machine to reason in a fashion similar to a human.

First Order Logic, or Predicate Calculus, is the logical cornerstone of symbolic processing. One of the early skills you need to acquire is the ability to translate English phrases to predicate form. It sounds fancy and complicated, but it's not. Basic predicate form looks like this:

predicate(argument1, argument2, ..., argumentn)

It looks a lot like a C, BASIC, or Pascal function call. First Order Logic, or FOL, is concerned with objects and the relationship between objects. The general form is translatable to

relationship(object1, object2, ..., objectn)

The predicate or relationship is usually an action taken, or something verb-like in form. The arguments or objects are the things that the action is taken on.

Objects usually translate to noun-like forms. The predicate and its arguments are called a clause. The number of arguments in a clause is called the "arity" of the clause. If someone says, "this clause has an arity of four," then you know that the predicate they're talking about has four arguments.

Let's look at an example. Take the sentence, "Mary likes beer. How would you go about translating this sentence to FOL? First, find the objects in the sentence. There are two, Mary and beer. Notice that the objects are nouns. Next, look for the relationship between the objects. The relationship is "likes," which is a verb. All of the components of the sentence are identified, so now we can translate it into clausal form. To follow the translation all the way through, start with the "textbook" form:

predicate(argument1, argument2, ..., argumentn)
translates to:
relationship(object1, object2, ..., objectn)
we know that:
relationship = "likes"
object1 = Mary
object2 = beer
so the final predicate form is:
likes(Mary, beer)

This seems like a lot of work to go through just to translate a simple sentence, and it is. With a little practice, you'll easily translate complicated phrases and sentences in your head. It's important to realize that the translation process is constructive and algorithmic in nature. If it's an algorithm, then it can be performed by a machine.

First Order Logic is a convenient way to represent objects and relationships in a machine. All the world is information in one form or another. First Order Logic is one way of making sense out of this deluge of information. Using FOL, you can create a small set of rules to process volumes of information.

Free AI Tools on the World Wide Web

The Web provides an unparalleled resource for AI tools, papers, and tutorials. To get free versions of LISP and Prolog, the best place I've found is the Brighton University Resource Kit for Students, or

BURKS. You can download a shareware LISP interpreter, freeware XLISP, a free Common LISP interpreter, as well as three free Prolog implementations.

The format of this site is a gold mine for programmers. You can download shareware and free versions of 24 different languages. Each of the languages have a page that's split into three sections: Development Tools, Tutorials and FAQs, and External Resources. This site offers hard-to-find languages such as ML, Haskill and Python (named for Monty Python's Flying Circus).

The LISP Resources site from Harvard is a Spartan, but good site with valuable links to LISP-related sites. It also contains a link to John McCarthy's home page. Make sure you check out McCarthy's page. It's loaded with interesting papers (most authored by McCarthy) that you can download. A lot of the papers are of significant historical interest such as the original April 1960 paper where LISP was first described.

Like McCarthy's page, Marvin Minsky's home page is current, as well as historical, and contains a wealth of information and opinion. See Figure 1 for a listing of AI websites.

AI-Related Books

There are boatloads of textbooks available on all facets of artificial intelligence and AI tools. If you can't find what you're looking for on the web, then the next best place to look is at a local university library or one of the larger booksellers. Figures 2, 3, and 4 list and review books on LISP, Prolog, and related artificial intelligence titles.

You can do a lot on your own with the tools and concepts described here. Think big, take little steps, and don't let miniature minds get in your way. It's within the domain of the hobbyist and independent researcher to create small autonomous robots running neural nets for "reptile brain" functions and LISP programs for higher reasoning functions.

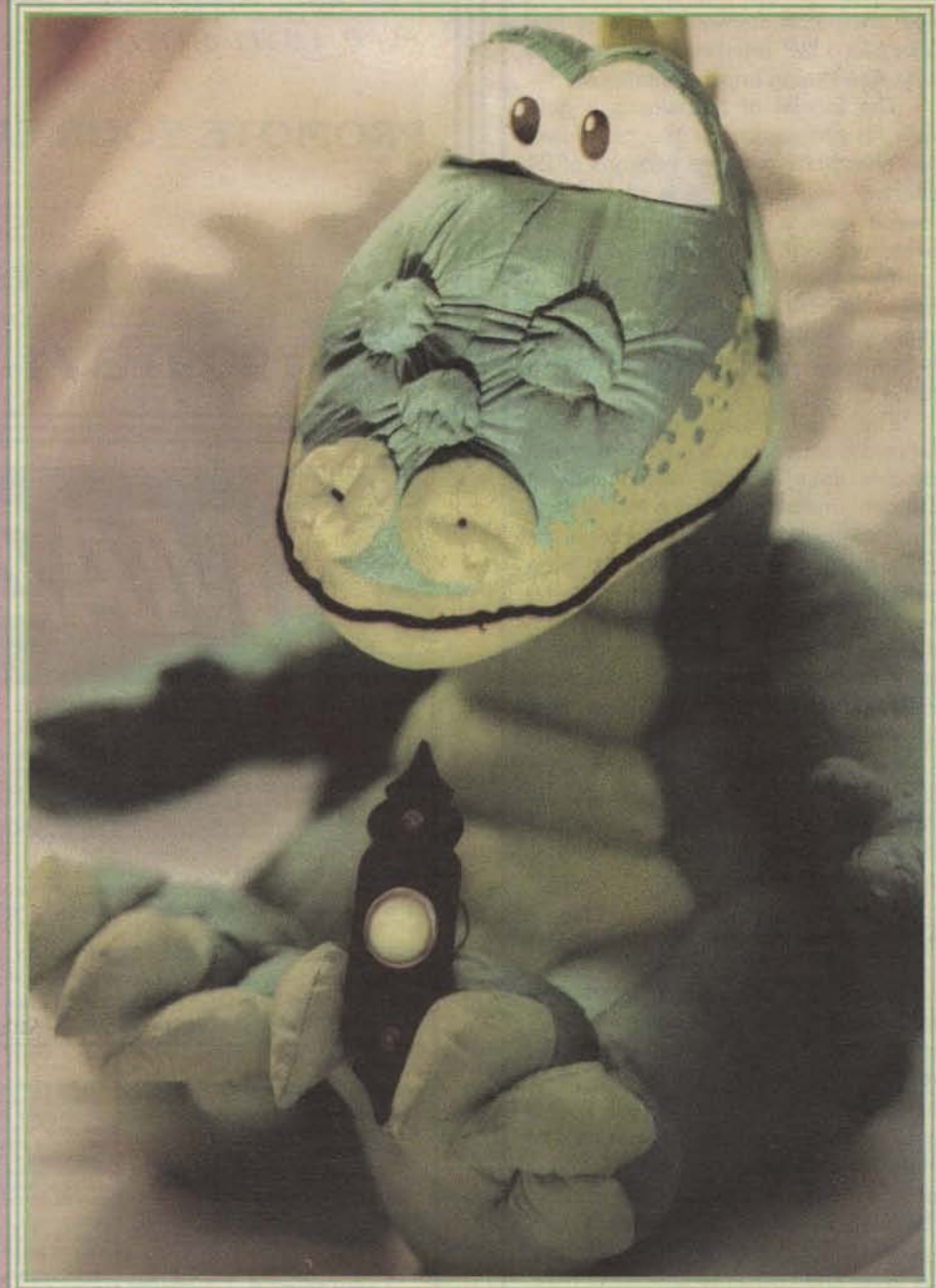
Don't listen to people who say "you can't do that" or "no one would ever want that. Avoid that limited, short-sighted mindset. When I hear someone say something like this, it reminds me of what the Chairman of the Digital Equipment Corporation said in 1977; "There is no reason for anyone to have a computer in his home." Ironic, isn't it?

Working in artificial intelligence is occasionally frustrating, but mostly exhilarating. When your LISP or Prolog program answers your query in a totally unexpected, but intelligent manner, or your little robot acts like it's thinking on its own, you get a tiny chill of excitement and a feeling that you're dealing with something more than a mere machine. Who knows?

Someday, when we're gone, there may be robot archeologists roaming the earth, sifting through ruins, finding old chunks of computer hardware and software, and considering them to be the silicon genetic components from whence they came. **NV**

Forever Doorbell

by Kenton Chun



It never fails that, at least once a year, the doorbell button needs to be replaced. It is usually the day before Halloween, when several hundred visiting goblins are expecting to see the welcome glow of the doorbell light.

Of course, since the doorbell light is only a cheap incandescent grain-of-wheat bulb, it burned out only a few months after it was installed. At $4.95 a pop, this can be irritating, not to mention a waste of an hour or two to replace the doorbell light assembly in the doorjamb.

This month's project is a doorbell light which should last almost forever.

The typical doorbell light is simply a small incandescent lightbulb wired in parallel to the doorbell switch. Its resistance is high enough that it doesn't pass enough current to activate the doorbell chime. It is expected to burn constantly, day and night.

When the doorbell button is depressed, the contact is closed, effectively shorting out the lightbulb in the doorbell button. That is why it goes off then the doorbell button is pressed. It is also the only time in a doorbell light's short life when it is not lit.

There are 8,766 hours in a year. Since a common doorbell light seems to have trouble lasting even this long, the author decided to see if he could do better.

LEDs

Light-emitting diodes have been around for quite a few years. Unlike incandescent lightbulbs, they have undergone a continual refinement process so that now a good quality LED has an expected MTBF (Mean Time Between Failure) of 350,000 hours. This means that an LED could last almost 40 years!

A doorbell light using a light-emitting diode could conceivably outlast the door or even the house. Depending on the color you select, your doorbell light can look just like it does now, or have a new festive holiday glow.

Getting Started

Go out and buy a new doorbell button. Hopefully, it will be the last. Carefully disassemble it by bending the tabs on the back so that they are straight. This will allow the button to be separated from the contact assembly (Figure 1).

Figure 1: Separating the button from the contact assembly.

Use a small screwdriver to separate the button from the contact assembly, being careful not to crack them or bend the contacts. Each side of the switch will have two contacts for a total of four. The light will be in the center of the contact assembly.

It will look like a Christmas tree light bulb. Its pigtail leads will be wound around two of the contacts. The bulb may be held in place with a small glob of contact cement (Figure 2). Remove the bulb and unwind the pigtail leads from the doorbell switch contacts. Clean out any remaining contact cement in the assembly.

Figure 2: Removing the incandescent bulb.

The Modification

Get your soldering iron good and hot, and get the tip nice and clean. There are many colors of LEDs available and the author decided to use green to be different. Yellow will most resemble the original color of the doorbell light. Feel free to use red or even blue, if you wish. They all look fine behind a white button assembly. Check with the parts distributors in this publication for a wide range of interesting choices.

Cut the LED leads off close to the device. Leave enough lead to solder to. You may also have to bend the leads with a pair of hemostats or needle-nose pliers to get them to reach the button contacts.

Prepare the resistor. Typical doorbell systems run on 18 VAC. Using Ohm's Law, in order to get 30 mA through the LED will require a 600-ohm resistor (18V ÷ .03A = 600 ohms). Although this equation applies to DC calculations, it is close enough for our needs.

The author chose a 562-ohm, 1/8-watt epoxy encapsulated type. The important thing here is to find one that is as small as possible. It must fit inside the contact assembly with the LED.

Cut the resistor's leads close enough so that it will fit into the contact assembly, preferably under the LED (Figure 3). Solder one side of it in place, on one button contact.

Next, tin both the remaining resistor lead and the LED leads. Hold the LED leads with a hemostat or needle nose while soldering to prevent heat damage to the device. Solder one LED lead to the resistor and the other to the opposite button contact.

You must select the contact diagonally opposed to the one you soldered the resistor to, otherwise you will be connecting everything to the same side of the switch! Make sure the LED is centered in the contact assembly and that it

Figure 3: Resistor placement.

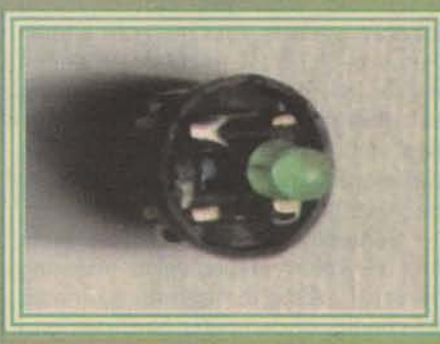
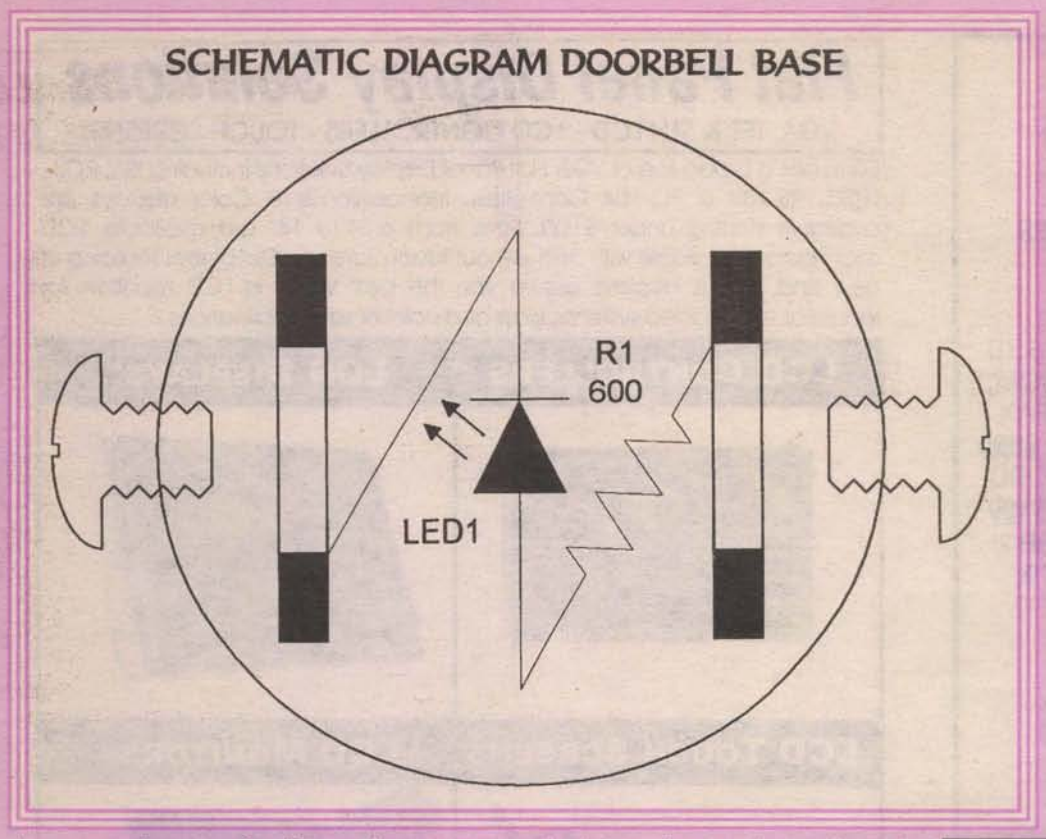


Figure 4: LED placement.



does not stick up too far. (Figure 4).

The LED polarity does not matter because it will be connected to an alternating current source. Also, be careful not to touch the plastic base of the switch with the iron – it will melt.

Re-assemble the button and the contact assembly. Push the tabs through the contact base and bend them down. Make sure the button does not hang when it is depressed and the LED does not strike the back of the button.

Test the button assembly by connecting it across the doorbell power wires, or an 18-VAC power supply. It should light up. *Don't press the button!* If you wish to test the button, be sure to connect a load in series with the button before pressing it, otherwise you may blow your power supply! Any 12-volt auto light bulb will work as a test load. If you use the doorbell power supply wires, the doorbell should ring when the button is pressed.

Final Considerations

The LED modified doorbell button can be used as-is, but you can do a couple of other things to increase its life.

The button and contact assemblies are obviously not sealed in any way, and you may wish to spread a tiny bit of caulk or gasket sealer into the crack between them in order to further weatherproof the switch. Also, the author discovered that, after about four years, the plastic push button assembly began to crack from ultraviolet exposure.

If you carefully paint the front surface of the push button with two-part epoxy — using a Q-tip or tiny brush — you can protect the plastic button from UV breakdown.

Be careful not to use too much epoxy or you may glue your button permanently, which might not be a bad idea if you don't like to answer your door!

Some doorbell button manufacturers actually make push-button assemblies that can be unscrewed or twisted apart to get at the light bulb inside. These are especially easy to modify.

Conclusion

A reliable doorbell button seems like a fairly minor thing until you have to replace it under time pressure, or in lousy weather. This doorbell button light will not only save time and money in replacement costs, but it actually uses less than half of the electricity that the original incandescent doorbell light used.

If you are living in a solar electric house, every little bit of saved power helps. Be the first one on your block to have a "green" doorbell, and next time be ready for those holiday guests!

Remember to have fun, whatever you do! NV

Parts List:

1 "Stock" doorbell button assembly (see text).
2 600-ohm 1/8-watt epoxy resistor
1 Light-emitting diode (see text).

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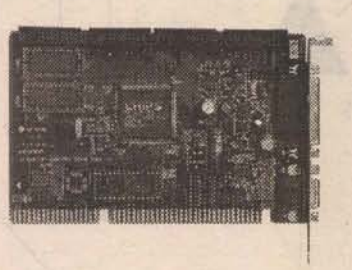

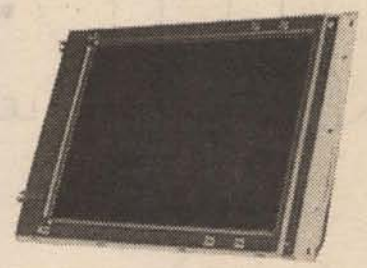

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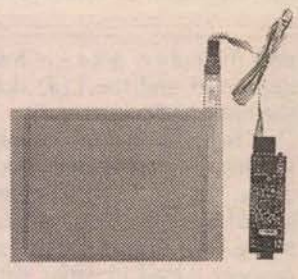

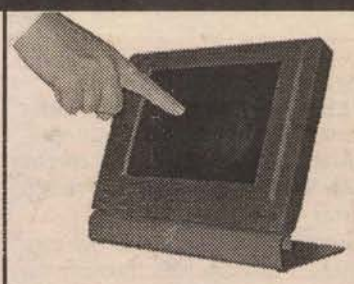

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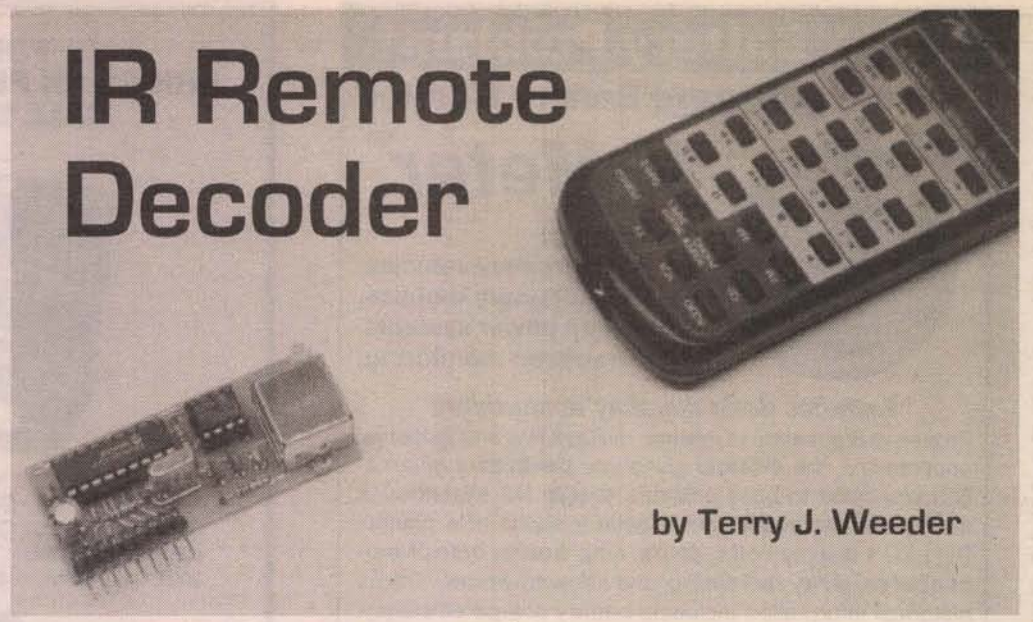
IR Remote Decoder



by Terry J. Weeder

Thanks to the outbreak of remote-operation technology into the consumer electronics market over a decade ago, the days of having to get up out of your seat to change the TV channel or start the VCR have long been forgotten.

TV remotes have become commonplace in a typical household, and replacement/spare units can be easily obtained dirt cheap from local vendors. Because of this, the hobbyist or professional designing customary circuits can inexpensively draw from a pool of off-the-shelf hand-held user interfaces to support remote control and/or keypad entry in their designs.

The trick is deciphering the protocol used by these transmitters, and converting the received data into something which can be conveniently processed in a circuit.

The IR Remote Decoder kit — as explained in this text — bridges this gap by providing direct input from a standard remote transmitter to any SBC (single board computer) or other digital circuit. A five-bit parallel port is used to indicate which of up to 32 buttons on a remote transmitter is being pressed at any given time. A CD (carrier detect) pin indicates presence/duration of a valid IR signal, and an EN (output enable) pin allows the parallel port to share a data bus with other peripherals.

This device can be used with most standard IR remote transmitters regardless of make or model. Simply place it in its programming mode, point a remote transmitter at it, and press the buttons you wish to assign to each successive binary number. The data patterns transmitted at each button press are sampled and stored in non-volatile memory, which is then used as a decoding template. The decoder can be re-programmed at any time for use with a different transmitter or configuration.

Once a unit has been programmed to respond to a particular transmitter, other units can quickly clone this configuration using a two wire (data plus ground) serial interface. This eliminates the need to repeat the tedious process of pressing each of the up to 32 buttons on the remote when programming multiple units.

Remote Transmitters

The standard infrared remote control transmitter used to control your TV, stereo, VCR, cable box, etc., uses a photo diode which transmits in the near infrared range and is pulsed on and off at a 40-KHz rate or close to. The purpose of this 40-KHz carrier is to allow the receiver to differentiate between it and ambient light which falls within the infrared range.

This carrier is modulated by being transmitted in short bursts as shown in Figure 1. By alternating the exact length of the burst, or time between bursts, it is possible to encode intelligent data on the IR signal; this being the method used by these remote control transmitters to indicate which button is being pressed.

For example, a long burst or pause may be used to represent one logic level in a bit stream, a short one representing the opposite. Each button on a transmitter is assigned its own unique bit stream and is sometimes transmitted in both true and complement form for error contingency.

Figure 1a shows an IR signal from a transmitter which encodes its data by alternating the length of the burst, while Figure 1b shows one which alternates the pause between bursts. There are also a small number of remotes which alternate both length of burst, and time between bursts.

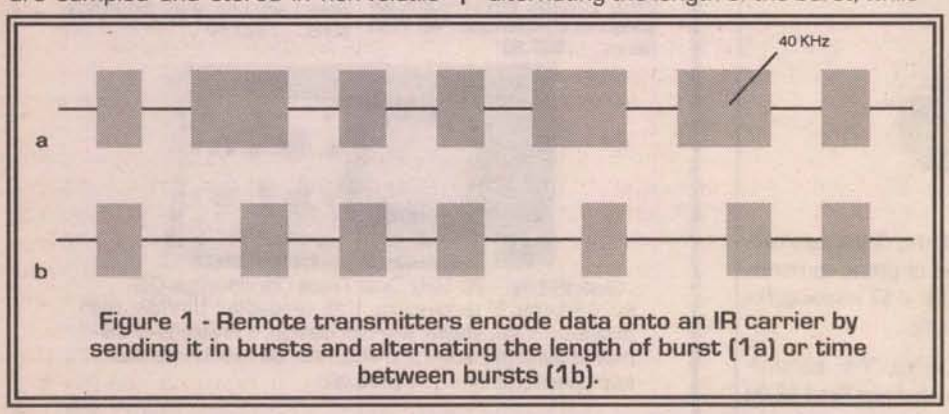


Figure 1 - Remote transmitters encode data onto an IR carrier by sending it in bursts and alternating the length of burst (1a) or time between bursts (1b).

A typical receiver in a host product will decode the individual logic levels in the data stream using a time base operating at the same frequency as one within the transmitter. Although the frequency of this time base varies among manufacturers — as does the choice of alternating the length of the burst or that of the time between bursts — the same basic principle applies and can be utilized in a universal decoder.

In most cases, the IR signal consists of a pattern of anywhere from 12 to 16 bursts of 40 KHz infrared — there is, however, a small percentage which use a longer data stream. Some models continuously repeat this pattern, while others send their data stream only once or twice, then cease transmitting even though the remote's button is still depressed.

Circuit Theory

The circuit is made simple by the self-contained infrared Receiver/Demodulator (MOD1). A block diagram of the IR module is shown in Figure 2. The modulated IR signal is detected by the photo diode which has its peak sensitivity in the near infrared range. After passing through a preamplifier/limiter, the built-in band-pass filter then rejects all signals outside the pass band of 40 KHz. This reduces or eliminates false operation caused by other light sources.

The remaining signal is fed to the demodulator, integrator, and comparator which outputs a clean TTL level pulse stream without the carrier. Figure 3 demonstrates the output pulse of the IR module with respect to the remote control transmitter's signal being received at its input. Note, how the presence of an IR burst (Figure 3a) produces a low at the output of the IR module (Figure 3b). Photos 1 and 2 are IR pulse streams which were captured from the output of MOD1.

Refer to the schematic diagram shown in Figure 4. The heart of the circuit is the microcontroller IC1, a PIC16C54 manufactured by Microchip. Its internal oscillator is set by the 4-MHz crystal XTAL1 and load capacitors C2 and C3.

IC1 receives the demodulated IR burst patterns from MOD1 via port-a, bit 0. These patterns are sampled and stored/compared to those in the EEPROM IC2, a 93LC66 also manufactured by Microchip. Bits 1, 2, and 3 of port-a are used to communicate with IC2. Data is transferred to and from IC2 by setting the CS (chip select) pin high, then using the CLK (clock) pin to serially shift in/out data via the DI (data in) and DO (data out) pins.

Because the DI and DO pins share the same I/O pin of IC1, resistor R3 is used to limit the current flow during those transition times between "read" and "write" when there are conflicting logic levels.

IC1 uses port-b to communicate with the outside world. Bits 0 through 4 serve as a tri-state parallel port to place the binary code which matches any decoded IR data strings. Bit 5 is used as an output enable pin; externally pulling this pin low will force bits 0 through 4 into a high-impedance state. This pin is also used for serial communications when cloning (more on this later).

Bit 6 is a carrier detect output and is set high whenever a valid IR data string is being received. Bit 7, when pulled low, will instruct IC1 to start the programming sequence and turn on LED1.

PIC Firmware

The PIC16C54 microcontroller must be programmed with the "IR Remote Decoder" firmware before installing. A pre-programmed PIC can be obtained from the source mentioned in the parts list. The source and object code files are available from the *Nuts & Volts* web site for those who have the proper equipment to program their own, or simply wish to explore the program line for line.

As mentioned earlier, the exact pro-

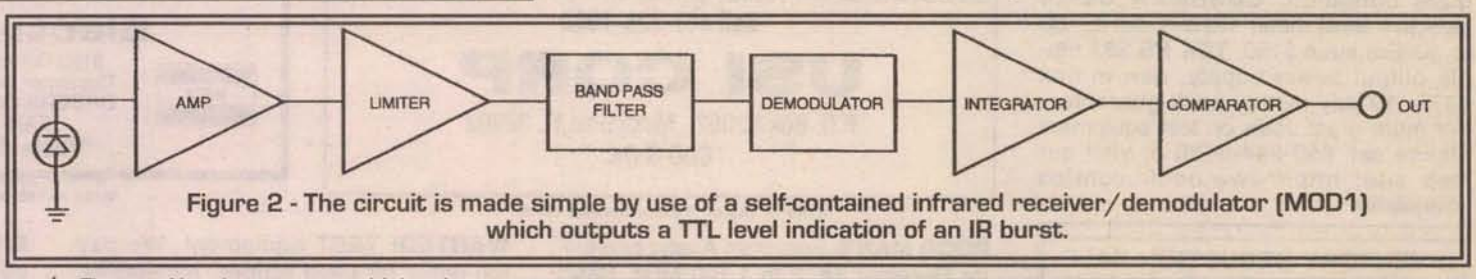


Figure 2 - The circuit is made simple by use of a self-contained infrared receiver/demodulator (MOD1) which outputs a TTL level indication of an IR burst.

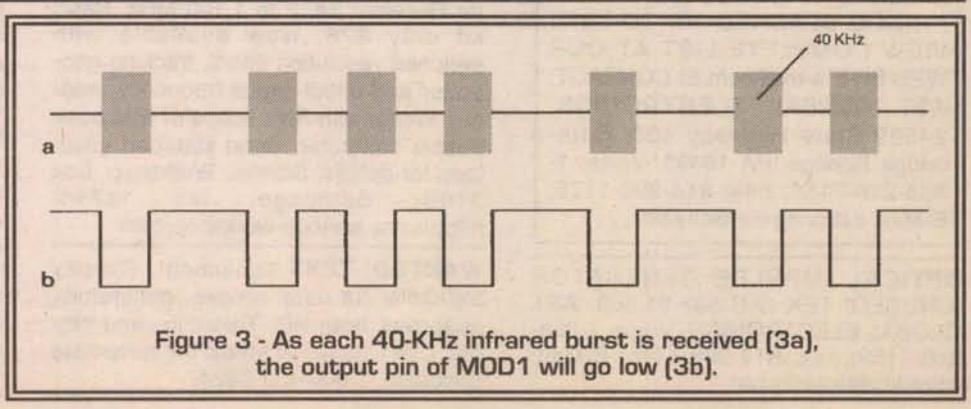


Figure 3 - As each 40-KHz infrared burst is received (3a), the output pin of MOD1 will go low (3b).

tocol used to indicate the different logic levels in the data stream transmitted by a typical IR remote control varies from manufacturer to manufacturer. Because of this, when recording the data streams related to each button on the remote, the firmware in IC1 is configured not to try to identify "1"s and "0"s, but instead, to measure the width of each burst and the time between bursts, storing these values in memory. This pattern can then be used to find a match

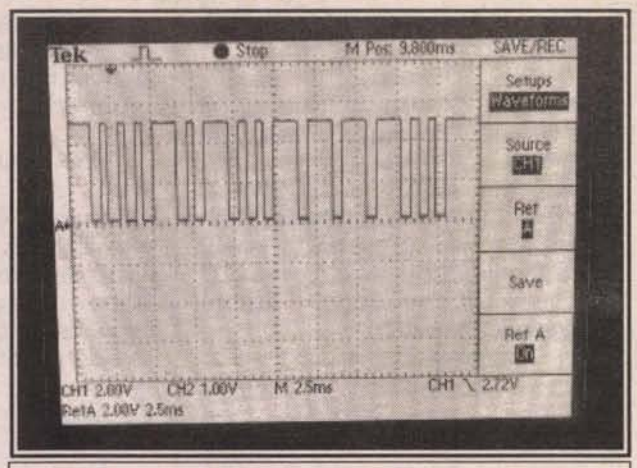


Photo 1 - Output captured from MOD1 when receiving an IR burst pattern from a transmitter which alternates the time between bursts.

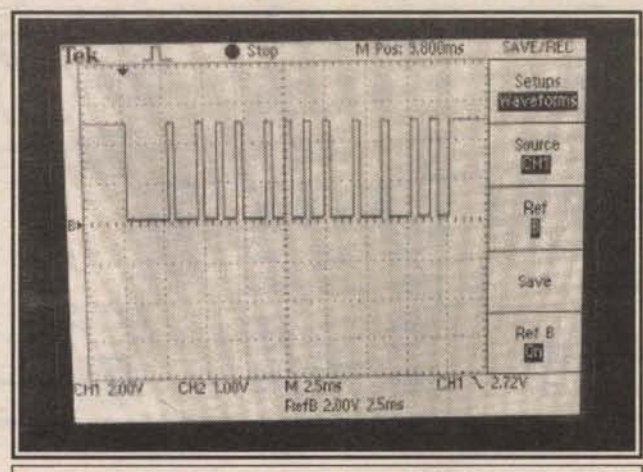


Photo 2 - Output captured from MOD1 when receiving an IR burst pattern from a transmitter which alternates the length of each burst.

After all contents of memory have been transferred, the LEDs on both the master and slave will turn off. The slave is now an exact replica of the master.

During normal operation, IC1 waits for any IR signal to be received, determines its burst pattern in the same way as in the programming mode, and looks for a match in memory. If it finds a match, IC1 sets the CD pin high and places the binary code associated with the burst pattern

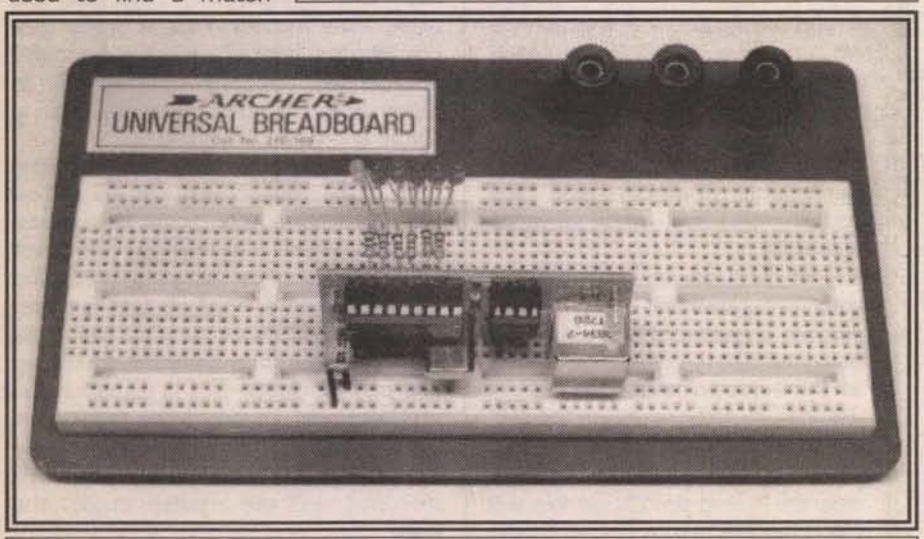


Photo 3 - Hook up LEDs in series with 620-ohm current limiting resistors to each output for visual indication during testing.

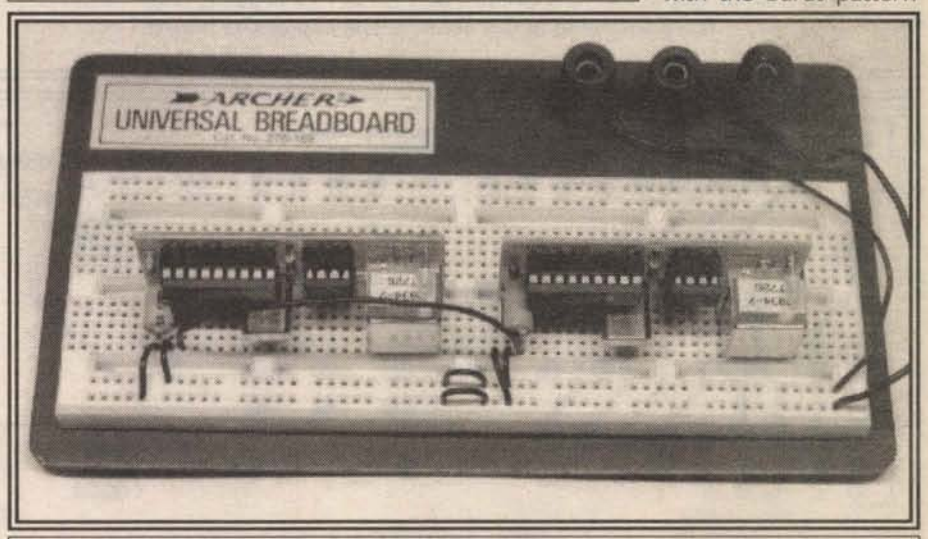


Photo 4 - Multiple units can copy the configuration of a master simply by jumpering their EN pins together and placing the slave in programming mode.

while in normal operation.

When measuring, unfortunately there are only 16 eight-bit registers available in IC1 to process and hold these values before sending them to memory. Since both the bursts and time between bursts must be measured, a 16-burst pattern will require 32 measurements. Because we are only concerned with a "change" in length rather then the "actual" length, high resolution is not a necessity and each eight-bit register can be divided in half to store both the burst length, and time between bursts.

In cases where the remote transmitter uses a data stream longer then 16 bits, the pertinent data relating to which button is being pressed is most often found at the end, therefore, IC1 automatically measures and records the latter 16-bits in all data streams. The IR Remote Decoder was tested using a universal remote control which was programmed to simulate 496 different remote transmitters. Only 7% of those did not work using the scheme mentioned above.

When placed in the programming mode, IC1 turns on LED1 then transmits a clone request byte out of its com port. This is merely a "01010101" pattern which will alert any connected master that a slave is wanting to copy it. If no confirmation is received from a master, IC1 waits for the presence of an IR signal – pressing of a button on a remote control transmitter.

A set of up to 32 bursts are sampled from the beginning of the IR signal's data stream, measured, and the later 16 are stored in IC2; this pattern being assigned to binary number b00000. IC1 then flashes LED1 to indicate that the recording process is complete for that button, and waits for the next button to be pressed.

Each subsequent button which is pressed is sampled in the same way as above and assigned the next incremented binary code. After recording the data patterns for 32 buttons, or if more than 10 seconds lapses without input, IC1 ends the programming process and turns off LED1.

In cases where the IR Remote Decoder has its com port tied to that of another, the former will detect the clone request byte at the beginning of the programming process, turn on its LED, and respond by sending this same byte back to the slave. The master will then dump the contents of its memory to the slave one byte at a time, the slave confirming transfer of each byte.

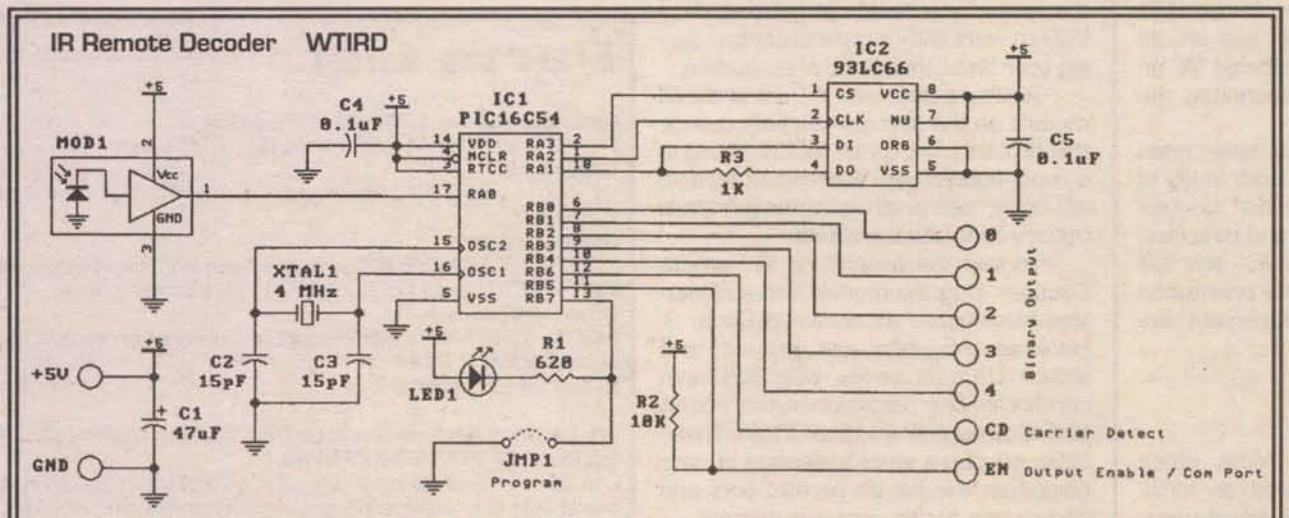


Figure 4 - A PIC16C54 microcontroller (IC1) decodes the IR burst pattern received from MOD1, compares it to a template stored in the EEPROM (IC2), and places the matching binary code on the output pins.

on the output pins. When the IR signal ceases, IC1 sets the CD pin back low and waits for another IR signal.

Construction

The circuit board has been designed to boast a small footprint, measuring only 1" x 2.4". The artwork is provided here for those who wish to fabricate their own, or a pre-etched and drilled PCB can be obtained from the source mentioned in the parts list.

Refer to the parts placement diagram shown in Figure 5. Identify the component side of the board which is marked, and begin by soldering in the two IC sockets used for IC1 and IC2. Next, mount the resistors and capacitors being careful to use the correct orientation with the polarized capacitor C1.

The crystal (XTAL1) should be installed with a small gap between it and the PC board to avoid inadvertently shorting the two pads together with its metal case. A gap should also be used underneath the IR module (MOD1) to keep its grounded metal case from touching any traces on the top of the

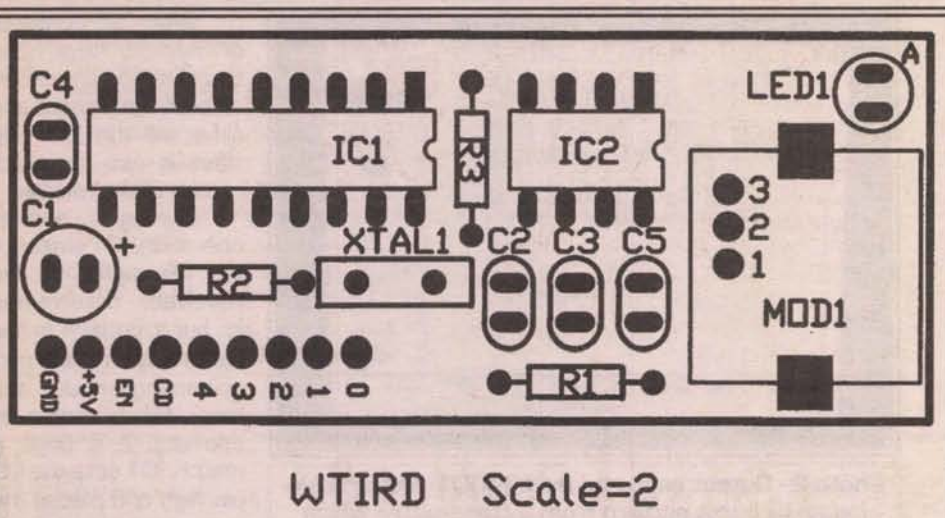
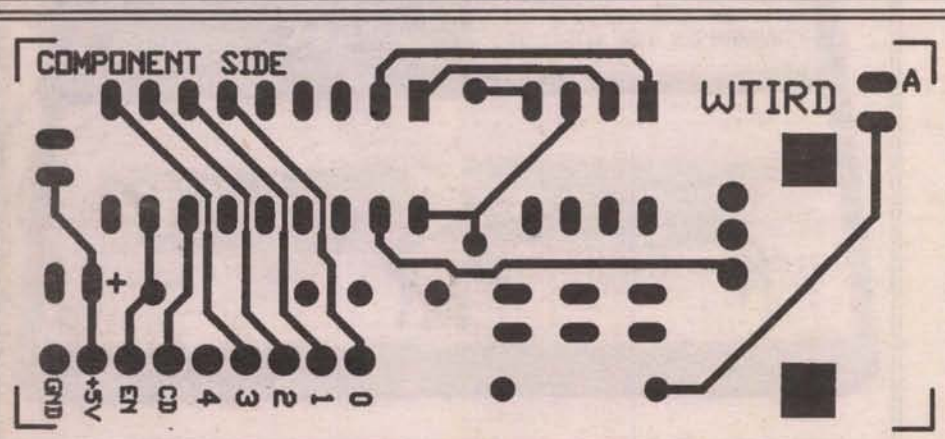
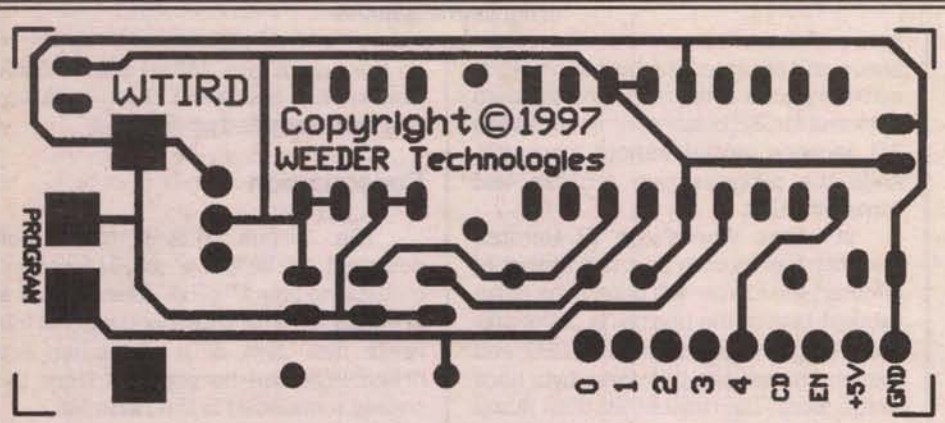


Figure 5 - Use this parts placement diagram when assembling the PC board. Leave a small gap under the crystal and MOD1 to prevent their metal cases from touching any traces on the top of the board.



TOP LAYER/SCALE 2:1



BOTTOM LAYER/SCALE 2:1

PC board. When soldering in the LED, the long lead is the anode and should correspond with the pad labeled "A" on the PC board. Finish by mounting the right-angled SIP header.

After all components have been installed, closely examine both sides of the board looking for solder bridges and/or cold solder joints and re-solder, if necessary. Carefully plug IC1 and IC2 into their sockets using the orientation as shown in the parts placement diagram.

Operation

IMPORTANT NOTE. Most office buildings, labs, schools, and so forth, use fluorescent lighting. A lot of these lights flicker at a rate which is close to the 40 KHz used by an IR remote transmitter and will completely drown out its weak signal at the receiving end. This is the reason you could not get that darn VCR to work with a remote control during your last conference presentation.

Placing a filter lens in front of the IR module on the decoder will help reduce this problem, but a raw MOD1 sitting in a room flooded with fluorescent lighting will never see anything coming from a battery-operated transmitter.

To test the assembled IR Remote Decoder, plug the module into a solderless breadboard as shown in Photo 3. Hook up +5 volts and ground, and attach LEDs in series with 620-ohm current-limiting resistors to the output pins 0 through 4, and the CD pin. These LEDs will give a visual indication of data placed on the five-bit parallel port and show when a valid carrier is present.

Select a suitable remote control transmitter, apply 5 VDC to the decoder module, then short the two programming pads together with a screwdriver. These pads are located on the solder side of the PCB near MOD1.

The LED on board the module will light indicating that it is in the programming mode. Hold the remote transmitter at least three feet away, point it at the input of MOD1, then press and hold the button you wish to assign to binary number b00000. Wait for the LED to blink off then back on before releasing the button.

Now press and hold the button you wish to assign to binary number b00001, then b00010, then b00011, etc. Each button you press will be assigned the next incremented binary code. After all desired buttons have been entered, wait 10 seconds and the module will end the programming sequence and turn off the LED. If you reach the full 32-button capacity while programming, the sequence will automatically terminate. This program configuration is stored in non-volatile memory and will remain intact even when power is removed.

At this point, pressing any valid "programmed" button on the remote transmitter will cause its assigned binary code to be placed on the output pins and the CD pin will go high. After releasing the button, the CD pin will return to a low state and the output pins will be cleared. Pulling the EN pin low will place the five output pins in a high impedance state. The following is a detailed description of each pin.

Pin Description

0, 1, 2, 3, 4 - DATA OUTPUT

These digital outputs provide the binary code assigned to an IR burst stream. The outputs become valid when an IR burst stream has been received which matches a pattern in memory, and are cleared after a 100-ms pause in IR reception. These output pins are high impedance when Enable is at a logic 0.

CD - CARRIER DETECT

When high, this output pin indicates the reception of a valid IR carrier which has been sensed and decoded at output pins 0, 1, 2, 3, 4. CD remains high until a 100-ms pause in IR reception.

EN - OUTPUT ENABLE / COM PORT

Outputs 0, 1, 2, 3, 4 are enabled when EN is at a logic 1, and high impedance (disabled) when EN is at a logic 0. On-board pull-up resistor holds this pin high when not connected. EN also used as a serial port when cloning.

Cloning

Once a module has been programmed to respond to a particular remote transmitter, other units may copy this configuration. Plug both the slave and master into a solderless breadboard, hook up power and ground, and connect the EN pin of both boards together with a jumper wire as shown in Photo 4.

Short together the programming pads of the slave module and its LED will turn on. After a brief pause, the LED on the master will also turn on and it will begin dumping its program configuration to the slave. After all data is transferred, both LEDs will turn off. Note that the only difference between a master and slave is which one is placed in the programming mode. If the master is placed in the programming mode instead of the slave, the roles are reversed and the master copies the slave.

As in normal programming, the cloning process is not limited to one shot. IR Remote Decoder modules can clone another even though they have already been programmed. The old configuration will simply be erased.

During the cloning procedure, the slave verifies successful transfer of each byte by transmitting it back to the master. If for some reason the master does not receive the correct acknowledgement byte from the slave, it will terminate the cloning function and commence flashing its programming LED. At this point, both modules must be reset by cycling power, and the cloning procedure repeated. You can observe this error indication by disconnecting the EN jumper wire half way through the cloning sequence. **NV**

Parts List

Resistors (All are 1/4-watt, 10% units)
R1 - 620 ohm; R2 - 10,000 ohm; R3 - 1,000 ohm
Capacitors
C1 - 47 uF, 35-WVDC, electrolytic; C2, C3 - 15 pF, ceramic disc; C4, C5 - 0.1 uF, monolithic ceramic
Semiconductors
IC1 - PIC16C54-XT/P (Pre-programmed) eight-bit microcontroller (Microchip)
IC2 - 93LC66 serial EEPROM; LED1 - light emitting diode
Other components
MOD1 - 40-KHz Infrared Remote Control Receiver Module (Digi-Key part no. LT1060-ND or equivalent)
XTAL1 - 4-MHz crystal

The following items are available from **Weeder Technologies, P.O. Box 2426, Ft. Walton Beach, FL 32549. 850-863-5723.**
Complete kit of parts consisting of a double-sided plated-thru-hole etched and drilled PC board, and all board mounting components including a pre-programmed PIC16C54 (WTIRD-K), $32.00.
A pre-programmed PIC16C54 only (PIC-IRD), $16.00.
All orders must include an additional $4.00 for shipping and handling. Florida residents add sales tax. Visa and MasterCard welcome.

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SELL: HP 628A signal gen. 15-21GHz, $300; HP 606B sig. gen., $300; HP 4800 Vector Z meter, $600; HP 432A, 8478A, $350; HP 4260A, RCL meter, $250; HP 3455A DVM, $500; HP 3456A, $800; HP 3575A, phase gain meter, $800; HP 3580A spectrum ana., $900; HP 3310A, 5MHz function gen., $200; HP 1630D logic ana., $650; HP 1631D logic ana. scope, $1,500; Panasonic BT1300N video color monitor 14", $300; HP 1335A, XY storage scope, $250; HP 1332A, XY display scope, $250; HP 410C RF voltmeter, $200; Transistor fixtures, 11600B, $250; HP 11602B, $250; HP 11604A, universal extender, $150; HP 11720A, pulse modulator, $600, Heikmian 3901M communications test·system, $400; HP 8444A opt 59 tracking gen., .5-1300MHz, $1,200; A-Comm Electronics 303-290-8012.

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FG-513 $719.95, Digital sweep generator; Sine, Square, Triangle, Pulse, Ramp, TTL & DC; 2Hz-13MHz in 7 ranges; ±(.01%+1dgt).
Freq. Counter & TCXO: 5Hz-100MHz, 6.5 digits, x1 & x20 attntn.

FM STEREO MODULATOR

AG-2011A $549.00
RF SECTION:
Carrier: 98MHz ±2MHz;
Output: 10mV, 1mV & 0.1mV
COMPOSITE SIGNALS:
Pilot: 19KHz ±2Hz, 0.8Vrms
INT. MODULATION: 400KHz, 1KHz ±1%, 1Vrms, distortion < .5%; *L-R Separation*: >50dB.
EXT. MODULATION: *Freq.*: 50Hz-15KHz
L-R Separation: >45dB 100Hz-3KHz; >35dB 50Hz-15KHz.

AC MILLIVOLT METER

MV-3100A $159.95 wide band 5Hz~1MHz; 3 scales, mV, dB &dBm; 300μV~100V in 12 ranges, 10μV resolution; -70~40dB in 12 ranges, 0dB=1Vrms,0dBm=0.755V); ±3% accuracy; Input impedance 10MΩ; Noise <2%. **MV-3201B $309.95** dual channels, simultaneous measurement.

OSCILLOSCOPES

OS-7305B $249.00 DC~7MHz;
Vertical: 10mV/Div; Horizontal: 250mV/Div; 10Hz~100KHz in 4 ranges; 3" CRT; Internal and External Sync.; Input: 1MΩ/35pF.
OS-7010A ~~$369.0~~ $299.95 10MHz. 5" CRT, 10mV/cm~10V/cm, 1MΩ.
OS-622G $344.95 20MHz/dualtrace
OS-653 $699.95 50MHz, dual, delay sweep, ALT trigger, TV syn.
OS-6101$1499.95 100MHz, 4ch/8 trcs, delay swep,cursor readout

DIGITAL MULTIMETER

DMM-120 $24.95, 3½ digit, 600VDC/AC, 2ADC, 2MΩ, hFE/diode test.
DMM-123+Capacitance $44.95, 3½ digit, 600VDC/AC, 10ADC/AC, 2GΩ, 20μF, hFE/diode test, continuity beeper.
DMM-125 $54.95, Autorange/Bar Graph, 600VDC/AC, 2ADC/AC, 32MΩ, continuity beeper.
MIC-35 $59.95, Autorange, 3½ digit, LCD, 1000VDC/750VAC, 20MΩ, 20ADC/AC, diode/continuity check, data hold.
MIC-39 $149.95, Autorange/Bar Graph, True RMS, 3¾ digit, LCD, 40MΩ, 40μF, 1000VDC/750VAC, 20ADC/AC, 600KHz Freq. Counter, Data Hold, Drop-prove, Sleeping Mode, Memory, Read Functions.

GRID DIP METER

DM-4061 $89.95 1.5-250MHz, 6 bands; 6 plug-in coils, 2 transistor, and 1 diode.
Modulation: ≈ 2KHz Sinewave.
Crystal Oscillator: 1-15MHz.
Wave absorption meter. 9VDC battery.

AUTO DISTORTION METER

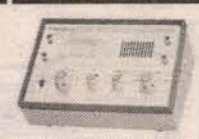
DM-3104A $799.95
MEASUREMENT:
Range: 0.01%-30%, 0.1/0.3/1/3/10/30% full scale.
Freq.: 400Hz±10%, 1000Hz±10%(HPF).
Input: 3mV-100V, ratio measuring 20dB.
Auto. Switching Ranges: Fundamental Freq. = (fo)±10%;
Fund. Rejection: >-80dB at (fo)±5%; >-70dB at (fo)±10%.
Harmonic Accuracy: ±0.5dB, 1.8(fo)-20KHz.
DM-3204 $1,599.00 dual channels.

FREQUENCY COUNTER

FC-5250C $119.95
Freq. Range: 10Hz-220MHz. (HF)10Hz-20MHz, (VHF)10MHz-200MHz
Gate Time: 0.1 & 1sec.
Max. Input: 10Vp-p.
Input Sensitivity: 35mV 10Hz-200MHz. *Display*: 7-digit LEDs.
Input Impedance: (HF) 1MΩ, (VHF) 50Ω.

FC-5260A ~~$146.00~~ $129.95
10Hz-600MHz. 7-digit LEDs.
FC-5270 $149.95
10Hz-1.2GHz. 8-digit LEDs.
FC-5600B ~~$321.00~~ $299.95
10Hz-600MHz. 10-digit LEDs.
(FC)5700 $329.95 10Hz ~ 1.3GHz. 10-digit LEDs.

SIGNAL TRACER/INJECTOR



SE-6100 $134.95
TRACER: Gain Max. 60dB
Attenuation: 0/20/40/60dB
Input Impedance: 100KΩ;
Output Imped.: 600Ω;
Speaker: 8 Ω.
INJECTOR: *Freq.*: 1KHz Squarewave; *Output Level*: Continuously variable 0 - 4.5Vp-p.

AUTO. CAPACITANCE METER

CM3300A $139.00 10 ranges, 99.9pF ~ 99.9mF, fully automatic.
Resolution: 0.1pF lowest, 0.1% full scale.
Accuracy: 0.5% of full scale±1 digit to 99.9μF, 1% of full scale±1 digit to 99.9μF.
Display: 3 digit LED.
Unit indicator: pF, nF, μF, mF. Overrange indicator.

WOW-FLUTTER METER

WF-3103A $699.95
Freq. Range: 3KHz±10% JIS/CCIR; 3.15KHz±10% DIN.
Range: 0.03/.1/.3/3% full scale.
Accuracy: ±5%.
WF-3105A $799.95, digital;
Function: LIN/WOW/Flutter/WTD.
Freq Counter: 10Hz-9.99MHz.
Indication: CCIR/DIN/JIS.

ELECTRONIC/PC TOOL KITS

9Z45 $29.99 U.S. Patented, 45-pcs. Contents: IC Inserter, IC Extractor with securers & Bows, 3-prong part Retriever, #0 Phillips Screwdriver, 1/8" Flat Screwdriver, Self-hold Tweezers, Metal Tweezers, Extra Parts Tube, Soldering Iron, Solder, Crimping Tool, Long-nose Plier, Cutting Plier, Zipper vinyl Case. Bits include: *Phillips*: #0, #1, #2, & #3; *Flat*: 1/8", 3/16", 1/4", 9/32"; PZ1, PZ2; T8, T9, T10, T15, T20, T25, T27, T30, T40, T45; *Hex*: 5/64", 3/32", 1/8", 5/32", 3/16"; *Sockets*: 3/16" (5mm), 7/32" (5.5mm), 1/4" (6mm), 9/32" (7mm), 5/16" (8mm).
8G23 $34.99 U.S. Patented, 23-pcs. Contents: IC Inserter, IC Tweezers, IC Extractor with securers & Bows, 3-prong part Retriever, 3/16" Nutdriver, 1/4" Nutdriver, 3/16" Slotted Screwdriver, 1/8" Slotted Screwdriver, #0 & #1 Phillips, Reversible T10/T15 Bits, Reversible #2 Phillips/¼" Slotted Bits, Tweezers, Long-nose Plier, Cutting Plier, 6" adj. Wrench, Soldering Iron, Solder, Crimping Tool, Zipper vinyl Case, Manual.

MICROPROCESSOR TRAINER

$699.00 learn 8088 hardware design and software programming.

Don Lancaster's

RESOURCE BIN

number seventy three

Insider secrets of surplus and auctions.

Our usual reminder here that the *Resource Bin* is now a two-way column. You can get tech help, consultant referrals, and off-the-wall networking on nearly any electronic, *tinaja questing*, personal publishing, money machine, or computer topic by calling me at (520) 428-4073 weekdays 8-5 Mountain Standard Time.

I'm now in the process of setting up my new *Guru's Lair* web site you will find at (where else?) *www.tinaja.com*

This is the place you'll go for instant tech answers. Among the many files in our library, you will find complete reprint sets for all of the *Resource Bin* and other columns. Plus a brand new Research InfoPack Service.

You will get the best results if you have both *Netscape Communicator* and *Acrobat Reader 3.0* installed.

Auctions and Surplus

With cold war meltdown, industry downsizing, research reductions, and revolutionary new electronics, there are literally tons of vintage electronic test equipment and used computers now going begging. Even at a tiny fraction of their original costs.

There is clearly a glut on the used electronics market. Fewer and fewer people seem willing to spend the time and effort to learn how to solder. Let alone learning, using, and profiting from personal electronic research.

Opporknockity tunes but once.

On the one hand, surplus *is* surplus because somebody does not want it anymore or there is something wrong with it. Old test gear does tend to be bulky and heavy, and some key parts might no longer exist. Manuals and schematics can get hard to find and might even end up costing more than the gear itself.

Then again, surplus is a great way to build up a lab or even start up your own tech venture.

For pennies on the dollar.

And a buck might be made buying low and selling high ...

If you are in the right place at the right time.

If you know your product.

If you have low-cost storage.

If you never pay more than six cents on the dollar.

If you can locate online storefront or direct mail buyers with minimal ad costs.

If you deal in just the right quantities.

If you stay lean and mean.

If nobody else tries exactly the same stunt at the same time.

And most especially ...

If the shipping charges and repairs don't eat you alive.

NEXT MONTH:
Don shakes down some resources about earthquakes.

The obvious starting point for most anything involving electronic surplus is right here in *Nuts & Volts.* Beyond these pages, though, you might find what follows to be of interest ...

Hamfests

The real gold mine for all electronic bargains is right where it always was: at a local *hamfest.* These are simply electronic flea market and tailgating parties put on by some local amateur radio club. There are many hundreds of these yearly, ranging from a few locals getting together up to the huge yearly blowout in Dayton, OH.

Here in Arizona, there are hamfests in Yuma, Tucson, Sierra Vista, Mesa, East Phoenix, Apache Junction, and Glendale locations. Along with the big regional July 4th weekend blast up in the Flagstaff high country.

The admission as a buyer is free to nominal, while sellers typically pay a $10.00 or so fee. Show times are typically from before the sun goes up to just after noon. You'll get the best genuine bargains at 5 am before any of the others spot the goodies. You also might pick up lots of junk for a song just before closing from sellers that have been issued an ultimatium to return alone and empty.

Or don't bother coming back.

One complete listing of upcoming hamfests shows up right here every month in *Nuts & Volts.*

Your master directory is the *ARRL Hamfest and Convention Calendar* at www.arrl.org/hamfests.html. Another useful hamfest calendar appears on the *virtual hamfest website* you'll find at *www.vhamfest.com.* They also offer commissioned online sales.

Alternatives to hamfests include computer swap meets or flea markets. Check your local surplus stores, clubs, shoppers, or bulletin boards to find out what is in your area.

Government and Military

At one time, the government and military sources offered outstanding surplus and auction bargains. These days, what remains isn't all that great, and they are only the tiniest shadow of what they used to be. For years now, commercial gear has been far cheaper and better than military.

Two long term resellers of military electronic surplus are my favorite *Fair Radio Sales* for the smaller stuff, and *Radio Research Instruments* for whole radars and giant dishes.

The feds have dramatically cleaned up and improved their surplus web site. You can even place bids online. Find this one at *www.drms.com* or use the link on my Guru's Lair website at *www.tinaja.com/dntkwb01.html.*

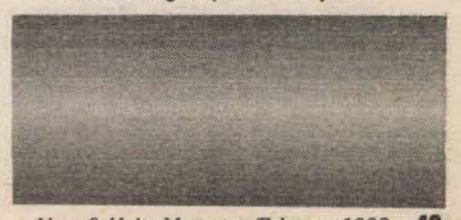
Military surplus has recently gone storefront. Many of the army or air force bases now have their own retail stores, and much is now sold direct, rather than by spot bids or auctions. Access hours may be limited. Details on the web site, or call your local base for specific details.

An obvious rule: *Never buy military surplus sight unseen!*

An interesting military surplus web site is the *Hot Sheets Worldwide* you'll find at *personalwebs.myriad.net/gspubl/home/html.* There's also a *Commerce Business Daily* magazine which lists surplus property sales by both civil and military agencies.

Electronic Surplus

There are two obvious classifications for electronic surplus, namely retail and wholesale. On the retail side, the all-time grand champion numero uno is *American Science & Surplus.* You'll find many hundreds of ads for other suppliers right here in *Nuts & Volts.* Several I find per-



RESOURCE BIN

A FEW SURPLUS AND AUCTION RESOURCES

Am Radio Relay League
225 Main St
Newington CT 06111
(203) 666-1541

American Sci & Surplus
3605 Howard St
Skokie IL 60076
(847) 982-0874

Army/Navy Mercandiser
445 Broadhollow Rd #21
Melville NY 11747
(516) 845-2700

ASD/AMD Trade News
2525 Ocean Pk Blvd
Santa Monica CA 90405
(800) 421-4511

Auction Hunter
2465 Grand Ave
Baldwin NY 11510
(888) 321-7653

Auction World
417 W Stanton Ave
Fergus Falls, MN 56537
(218) 739-4408

Auctioneer
8880 Ballentine St
Overland Park KS 66214
(913) 541-8084

B&B Auctions
3211 S 43rd Avenue
Phoenix AZ 85009
(602) 353-0016

Bentley Auctioneers
3801 Academy PN NE
Albuquerque NM 87109
(505) 344-1812

C&H Sales
PO Box 5356
Pasadena CA 91107
(800) 325-9465

Closeout News
728 E 8th St
Holland MI 49423
(800) 600-7040

Commerce Business Daily
US Dept of Commerce
Washington DC 20230
(202) 482-0632

Compu-Mart
899 Presidential #110
Richardson TX 75081
(972) 238-1133

Const Equip Monthly
1300 Central Ave
Ft Dodge IA 50501
(800) 247-2000

Contractors Equip Guide
50 Central Ave
Needham Heights MA 02194
(800) 225-8445

Electronic Buyers News
600 Community Dr
Manhasset NY 11030
(516) 562-5000

Fair Radio Sales
PO Box 1105
Lima OH 45802
(419) 227-6573

Factory Outlet News
11 Tory Lane
Newtown CT 06470
(419) 227-6573

Halted Specialties Co
3500 Ryder St
Santa Clara CA 95051
(800) 442-5833

Herbach & Rademan
16 Roland Ave
Mt Laurel NJ 08054
(800) 848-8001

Industrial Marketplace
7842 N Lincoln Ave
Skokie IL 60077
(800) 323-1818

Intl Closeout Dir
520 Fellowship Rd
Mt Laurel NJ 08054
(800) 326-8811

Marlin P Jones
Box 12685
Lake Park FL 33403
(407) 848-8236

Merchandise USA
2221 S Michigan Ave
Chicago IL 60616
(312) 791-0070

Missouri Val Shopper
329 Broadway St
Yankton SD 57078
(605) 665-5884

Nuts & Volts
430 Princeland Ct
Corona CA 91719
(909) 371-8497

Radio Research Insts
584 N Main St
Waterbury CT 06704
(203) 753-5840

Surplus Record
20 N Wacker Dr
Chicago IL 60606
(312) 372-9077

Surplus Traders
PO Box 276
Alburg VT 05440
(514) 739-9328

SW Auction Weekly
PO Box 61104
Phoenix AZ 85082
(602)994-4512

Synergetics
Box 809
Thatcher AZ 85552
(520) 428-4073

Time Line
1490 W Artesia Blvd
Gardena CA 90248
(800) 872-8878

Trans-Network Assoc
1870 E Beltway 8 #216
Padadena TX77503
(281) 479-7848

USA Closeout Directory
383 E Maine St
Centerport NY 11721
(516) 754-5000

Used Equipt Dir
611 US Hwy Rt 46 W
Hasbrouck NJ 07604
(800) 526-6052

sonally interesting do include *C&H Sales, Marlin P. Jones, Herbach and Rademan, Timeline*, and *Halted Specialties.*

Wholesale electronic surplus outfits advertise in *Electronic Buyer's News.* The once superb listings in *Electronic News* seem to be long gone.

My own favorite industrial surplus mag is *Industrial Marketplace.* This one has lots of wholesale electronic and mechanical stuff in it. But note that there's zero handholding or any lot splitting, and deals are almost always done "right now" by FAX. Their idea of long term is "outta here by lunch."

More on distress and remarketed items appears in a trio of Texas pubs. *CompU-Mart* for computers and some electronics, *The Mart* for printshop stuff, and *Telecom Gear* for phones.

Web Sites

Your best starting web site for these wholesale sources is *xcess.com.* My favorite wholesale surplus dealer is *Surplus Traders* at *www.73.com.*

There are bunches of surplus and auction sites on the web, electronic and otherwise. Start with the *NETIS Auctions on the Web* site at *www2.auctionweb.com/otherauc.htm* for dozens of banners and hundreds of hot links.

There's a *Trans Network Associates* site at *www.t-na.com* who claim to be your gateway to surplus, liquidation, and closeout merchandise.

Lerner Enterprises is supposedly a high profile site that specializes in closeouts and overstocks. Their web site is *www.salvage.net.* One obvious competitor is *Merchandise USA* at, of all places, *merchandiseusa.com.*

Closeout salvage merchandise info is offered by *www.freeyellow.com/members/captainbli/index.htm.* The *TraderNet* site up at *idss.com/tradernet* gives you buy-sell listings and hot sheets.

Schools

A lot of schools and community colleges are stupidly dropping their electronics programs. Several others are sharply scaling back on them. Or shifting into computer science from "hard" electronics. Some others are dumping early and ultimately highly collectible Apple and Commodore computers for as little as $1.00.

As a result, you should find some incredible auction bargains around. *If* you dig deeply enough into remote enough locations. I've seen a $25,000.00 theater lighting system sell for $19.00. What is ideal is if you are the only technical bidder remaining at the end of a lousy weather day at a remote and largely unpromoted auction site.

But do not get sucked into older printers and monitors. These largely have negative cash value due to their weight, storage bulk, repair, and the outrageous shipping costs.

Do watch out for inane locals who don't have the faintest clue what an older computer is worth. And never bid a price beyond a genuine bargain. Ferinstance, the current street price on a Mac LC II is around $60.00 or so. I saw dozens of these systems get bid up to an astounding $270.00 with monitor. But I grabbed a entire monitorless *pile* of them for $6.00 each.

With Ethernet cards, even.

Never pay more than fifty cents for a 286 computer. But do grab any and all "Black Apples" you can find.

The first method to find out about remote school auctions is to call them and ask. The second is through your regional auction directories.

Larger universities do tend to use both auctions and storefronts for their surplus property disposal. Unwanted items are initially offered to internal departments, then to nearby schools and nonprofit orgs, and finally to the general public.

I've found *www.dist.maricopa.edu/surplus/index.html* useful for access to Phoenix area community colleges.

This same site has links to surplus property disposal pages on our three universities: U of A, Tempe Normal, and NAU. Plus several links to local publications and auctioneers.

Chances are there's a web page for each of your nearby schools that does pretty much the same thing.

"Closeout" Merchandise

Here's the way those closeout drills usually work: Larger stores have all sorts of stuff left over they cannot sell, combined with customer returns, odd lots, shopworns, seasonals, damaged, remainders, and whatever. The stores and chains *pay* lean and mean salvage companies so much per truckload to haul all this junk off.

These salvage outfits remove the dregs, then categorize and repalletize all the remains. These skids are then resold, usually by the semi load.

It is super easy to let that salvage outfit's better customers pick over the skids, leaving you with utter and total trash. Scams also abound, especially among low-quality foreign imports.

And most especially online.

My nearest distress re-merchandiser picks up a trailer or two of this stuff every six weeks or so. Although their storefront enterprise is more or less working, they are clearly not getting filthy rich in the process.

They do get some electronics, but much of it is marginal or specialized. Every once in a while, though, a real gem or two pops up.

You might want to ask your local distress re-merchandiser when and if they get any electronics and how they dispose of it. Often, somebody else grabs it right off their truck. And, if they don't have the foggiest notion what it is, and if it is big enough and heavy enough, they just may offer it for a "name your price" song.

Needless to say, you *always carefully inspect the merchandise to be sure exactly what you are getting!* And *always make sure you have some reselling edge.*

One of the big problems with the "greater fool" theory of marketing is that you may be it.

At any rate, a rather useful tabloid magazine here is *Closeout News.*

There are also national *ASD/AMD* conferences that are useful for lots of contacts in this field. Las Vegas and Atlantic City are two popular spots. They even have their own *ASD/AMD Trade News.* See the magazine for the exact show locations.

The *International Closeout Directory*, that *US Closeout Directory*, and that *Factory Outlet Newsletter* might also be of interest here.

There is a lot of closeout stuff on the web, but I don't know of any good way to determine exactly who is legit and who might not be.

Let me know what you find.

Auction Publications

You'll find a lot of magazines that tell you which auctions are going to take place where. My favorite local one is *Southwest Auction Weekley.* This is primarily for Arizona and Southern California, and it mentions just about every kind of auction imaginable.

The *Auction Hunter* is a midwest regional pub, while *National Auctions & Sales* targets those state and federal property auctions. Also try *Missouri Valley Shopper* for that locale.

There's also an *Auction World* from *Kiefer Publishing.* You might also want to check the *Directory of Repossed and Surplus Property Sources* or the *Army-Navy Store & Outdoor Merchandiser.*

The great *Weekly Auction Bulletin* is mostly on industrial machinery and contracter's equipment. Penton's *Used Equipment Directory* is one competitor, while the *Contractor's Equipment Guide*

RESOURCE BIN

and a *Construction Equipment Monthly* are two others. *Industrial Machine and Supply Offers* covers overstocks, plant closings, and the related auctions. For really heavy stuff, check the *Surplus Record Machinery Directory*

Lots of possibilities here.

And, for a view from the inside, do check into *Auctioneer* magazine, for and about NAA members.

Auction Houses

It also pays to get on the mailing and faxback lists of auction houses which either specialize in electronics and computers or at least sometimes get around to offering it.

The best bargains in test gear in the world appears to come from *Bentley Auctioneers* at *www.bentleysauction.com.* Seems they've got the inside dibs on Los Alamos Laboratories and similar New Mexico federal sites. One nearby auctioneer who seems to offer a lot of *Intel* plant gear on a monthly basis is *B & B Auctions* in Phoenix.

Naturally, you'll want to gather in a list of your own favorites.

Always be nice to any auctioneer and make life as easy as you can for them. In turn, they *may* watch out for you on stuff you are interested in, and sometimes might split out or combine lots for you or shift auction times, or whatever. Auctioneers can sometimes use a little input in identifying some strange piece of tech gear. But only do so very low key and when and where obviously appropriate.

Do remember that the auctioneer's goal is to maximize seller profits.

Hence the hype and fervor.

For More Help

I have got my own little *Synergetics Surplus* bargain operation running at *www.tinaja.com /barg01.html.* Some test gear, some telephone accessories, and lots of Apple collectibles mostly. Even some remote rural land.

Nearly all of the referenced urls in this *Resource Bin* are hot linked in the online version you should be able to find at *www.tinaja.com /resbn01.html.*

More on creating your own tech venture in my *Incredible Secret Money Machine II*, per my nearby *Synergetics* ad. Some extra help on pretty near anything involving electronic surplus or test gear can be found by way of *www.tinaja.com /info01.html.*

This Month's Contests

For our contests this month, just tell me about any auction directory, any auction house, a school, or a military site providing useful electronics or any computer bargains that I do not already know about. I feel I might be missing a top secret insider wholesale electronic surplus directory or two. And there's bound to be dozens — if not hundreds — of local computer-oriented shoppers and such.

Or else tell me your favorite little known regional electronic reseller or computer swap meet.

There should be a largish pile of my new *Incredible Secret Money Machine II* books going to the dozen or so better entries, plus an all-expense-paid (FOB Thatcher, AZ) *tinaja quest* for two that will go to the very best of all.

Send all your *written* entries to me here at *Synergetics*, rather than to *Nuts & Volts* editorial. Let's hear from you. **NV**

Microcomputer pioneer and guru Don Lancaster is the author of 33 books and countless tech articles. Don maintains his no-charge US tech helpline found at ***(520) 428-4073****, besides offering all of his own books, reprints, and consulting services. Don also offers a free catalog full of his unique products and resource secrets. The best calling times are 8-5 on weekdays, Mountain Standard Time.*

Don is in the process of setting up his Guru's Lair at http://www.tinaja.com.

Full reprints and preprints of all Don's columns and ongoing tech support appear here. You can reach Don at ***Synergetics****, Box 809, Thatcher, AZ 85552. Or send any messages to his US Internet address of* ***don@tinaja.com***

NEW HEWLETT-PACKARD 141T CRTs. $195 EACH. We have quantities available. These are double boxed, unopened with 1985 date code, guaranteed. Price is $195 each plus shipping. Contact Brian at Kentronix. 732-681-3229 or FAX 732-681-3312. Mailing: PO Box 2444, Farmingdale, NJ 07727 or E-Mail brian@kentronix.com

TEK 1503 TDR cable tester, complete, $1,000; Tek 7912AD programmable digitizer, $500; Tek 475 oscilloscope w/opt 93, $500; Tek 466 storage oscilloscope, $400; Tek 464 storage oscilloscope w/DM44, $500. Call or fax 732-681-2032.

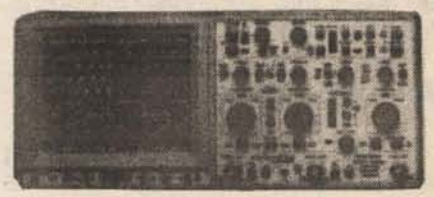
SCOPES FOR SALE: SONY/**TEK 336A** 50 MHz STORAGE W/CURSORS & IEEE-488 $950; **TEK 2465** 300 MHz 4ch $1,500; **PHILIPS PM3315** 60 MHz storage w/remote and plotter output $950, ser. manuals incl. Wallace Goin 360-871-7179, E-Mail: tgoin@ix.net com.com

HYDROGEN MASER information wanted. Looking for manuals for the Varian/HP H-10, as well as a complete unit. These are 1965 to 1968 vintage. For sale Cesium and Rubidium frequency standards. Repairs also performed with free estimates. Corby Dawson 805-736-0288.

BRAND NEW DMMs: Keithley 130A, 132F, 132C & 135A handheld 3 1/2-4 1/2 digit DMMs new in the box complete with accessories and some with temperature capability. For sale from $75 to $135. Quantities available. Contact Brian Lottich of Tru Cal at 1-800-681-5540. MC/Visa/Discover accepted.

LARGE ASSORTMENT of used test equipment for sale. Request list or visit my website. Credit cards accepted. Jim Stevenson, phone: 609-888-2846, Fax: 609-888-2847. E-Mail: JLStevenson@aol.com Website: http://www.stevensonlabs.com

WINTER CLEARANCE SALE: HP 8150A optical source, mint, $3,595. Also 8151A 81511A, 81519A. **Genrad** precision capacitance bridge, 1615A, 1316, 1238, late style, super clean, $2,795. GR 1383 noise generator $395. **Tektronix** 577D2 clean, bright w/fixture $1,595. 485 350MHz, excellent, $795. J16 photometer w/J6523 1° probe $595. CT-5 $395; Keithley 227 $595. 705 scanner $395. PM-1018B digital 18GHz power meter $695. **Free 12p. LIST** laboratory test equipment. **Call!** Joseph Cohen, 200 Woodside, Winthrop, MA 02152, 617-846-8223.



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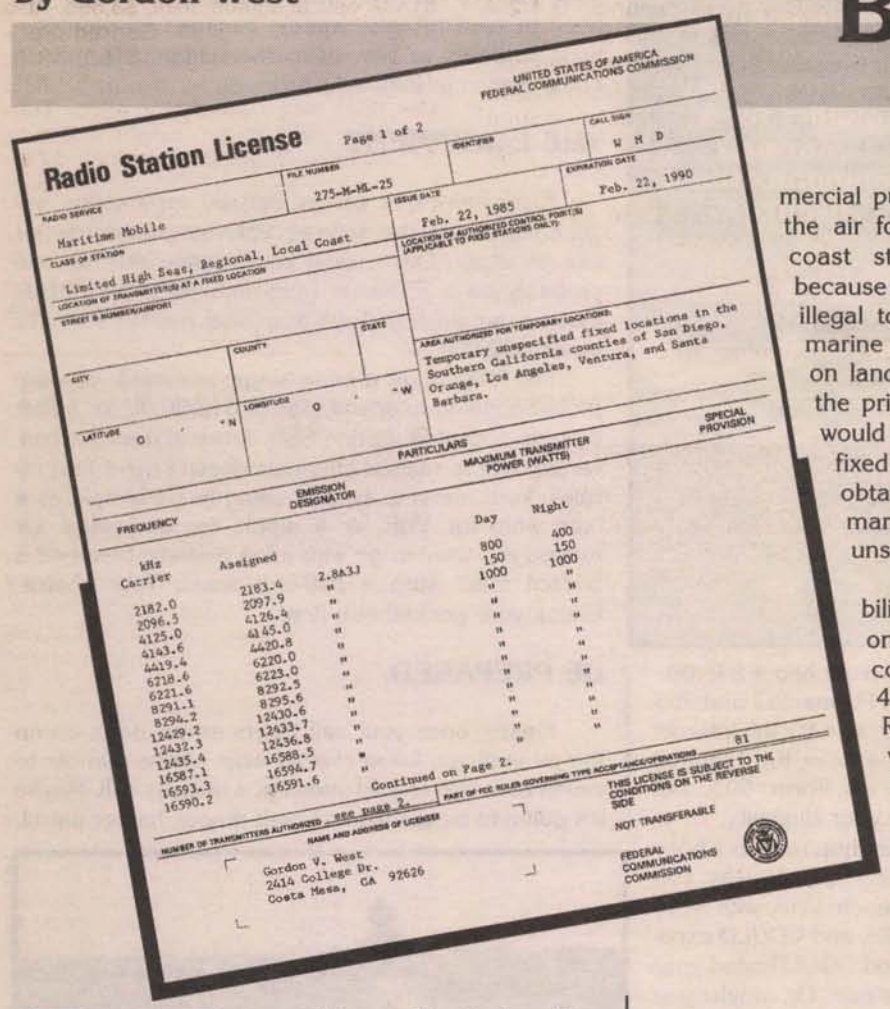
by Gordon West

BE AN FCC LICENSED SHORE STATION



UNITED STATES OF AMERICA
FEDERAL COMMUNICATIONS COMMISSION

Radio Station License Page 1 of 2

RADIO SERVICE: Maritime Mobile	FILE NUMBER: 275-M-ML-25	IDENTIFIER	CALL SIGN: W N D
CLASS OF STATION: Limited High Seas, Regional, Local Coast	ISSUE DATE: Feb. 22, 1985		EXPIRATION DATE: Feb. 22, 1990
LOCATION OF TRANSMITTER(S) AT A FIXED LOCATION		LOCATION OF AUTHORIZED CONTROL POINT(S) (APPLICABLE TO FIXED STATIONS ONLY)	
STREET & NUMBER/AIRPORT			
CITY	COUNTY	STATE	
LATITUDE: 0 ° N	LONGITUDE: 0 ° W		

AREA AUTHORIZED FOR TEMPORARY LOCATIONS:
Temporary unspecified fixed locations in the Southern California counties of San Diego, Orange, Los Angeles, Ventura, and Santa Barbara.

PARTICULARS

FREQUENCY: kHz Carrier	Assigned	EMISSION DESIGNATOR	MAXIMUM TRANSMITTER POWER (WATTS) Day	Night	SPECIAL PROVISION
2182.0	2183.4	2.8A3J	800	400	
2096.5	2097.9	"	150	150	
4125.0	4126.4	"	1000	1000	
4143.6	4145.0	"	"	"	
4419.4	4420.8	"	"	"	
6218.6	6220.0	"	"	"	
6221.6	6223.0	"	"	"	
8291.1	8292.5	"	"	"	
8294.2	8295.6	"	"	"	
12429.2	12430.6	"	"	"	
12432.3	12433.7	"	"	"	
12435.4	12436.8	"	"	"	
16587.1	16588.5	"	"		
16593.3	16594.7	"			
16590.2	16591.6	"			

Continued on Page 2.

NUMBER OF TRANSMITTERS AUTHORIZED: see page 2.

NAME AND ADDRESS OF LICENSEE:
Gordon V. West
2414 College Dr.
Costa Mesa, CA 92626

PART OF FCC RULES GOVERNING TYPE ACCEPTANCE/OPERATIONS 81

THIS LICENSE IS SUBJECT TO THE CONDITIONS ON THE REVERSE SIDE

NOT TRANSFERABLE

FEDERAL COMMUNICATIONS COMMISSION

How would you like to handle long-range, single-sideband, ship-to-shore communications to yachts and boats thousands of miles away at sea? Imagine the thrill of intercepting a Mayday call, and becoming a vital radio link to a US Coast Guard high seas emergency rescue operation.

Or, maybe you live near an ocean or river or big lake where all of the marine radio communications are on the 156 MHz VHF band. You can obtain a Federal Communications Commission (FCC) license to communicate ship-to-shore radio calls, and also become a vital part of guarding VHF marine Channel 16, the international distress and calling channel.

The FCC may allow up to 1,000 watts of peak envelope power on the marine long-range, single-sideband channels, and up to 50 watts of power output on VHF 156 MHz channels.

Your FCC authorized shore station could be part of your emergency search and rescue group, or a United States Coast Guard Auxiliary, or US Power Squadron radio system. You could set up your shore station as an emergency operation center specifically for guarding the worldwide or local frequencies to handle distress calls. Or, maybe you run a tow boat service, and you want to use your radio system to earn some business when a mariner runs out of gas at the harbor entrance.

Or, maybe you are going to run a youth camp down at the lake or river, and you are going to set your counselors up with handheld VHF transceivers on marine frequencies to coordinate kayaking or rafting. But just as long as you use your marine radio system for talking from shore-to-ship, or shore-to-shore in distress call handling, the FCC has a license just waiting for you to apply.

PRIVATE COAST STATION

The FCC classifies a shore station that will operate on marine radio frequencies as either private or public coast. A public coast station handles telephone calls for a fee, and there are plenty of commercial public coast stations already on the air for this purpose. The PRIVATE coast station is a well-kept secret because everyone knows it is absolutely illegal to use a marine VHF set or a marine single-sideband two-way radio on land or in a vehicle. *Wrong!* With the private coast station license, you would be eligible to operate from a fixed shore point, and might even obtain authorization to operate your marine station from a vehicle at an unspecified location, too.

The FCC rules that cover eligibility, frequencies, licensing, and on-the-air operation of a private coast station are found in Volume 47 of the Code of Federal Regulations, Part 80 to end. This volume is availability for $48.00 from the following organization:

Fair Press Services
P.O. Box 19352,
20th Street Station
Washington, DC
20036-0352
202-463-7323 (Phone)
202-463-8633 (FAX)

It's vitally important you have this FCC rule book in hand prior to applying for your private coast station license. You may also find this single volume quite helpful for all of the radio services it covers:

Part 80 — marine radio
Part 87 — aviation radio
Part 90 — land mobile radio
Part 95 — personal radio service, including CB
Part 97 — amateur radio service
Part 100 — direct broadcast satellite
Part 101 — fixed microwave

Operating a private coast station falls under Part 80, "Stations in the Maritime Services." More specifically, private coast station frequencies, licensing, eligibility, and on-the-air transmitting fall under Subpart K — "Private Coast Stations and Marine Utility Stations," Rules 80.501 to 80.519.

ARE YOU ELIGIBLE?

If you have any interest in ship-to-shore communications, you should be able to satisfy the eligibility requirement. To set up a marine shore station on either VHF shore-range FM channels at 156 MHz, or on long-range marine SSB frequencies, you must be engaged in some sort of marine activity. Under FCC Rule 80.501(a)(1-10), they will grant a private coast station license for the following activities:

- Boat repair shop
- Boat marine electronics dealer
- Dockmaster
- Shore pilot operation
- Dredging or marine construction
- Port captain
- Yacht club
- US Coast Guard Auxiliary or US Power Squadron unit
- Shore boat and water taxi
- Tow boat or marine mobile repair unit
- Vehicle servicing and oil-changing unit
- Vehicle harbor patrol or Coast Guard Auxiliary unit
- Vehicle electronic or mechanical serviceman unit
- Fishing store
- Live bait store
- Outboard motor repair store
- Sea Scout or youth camp headquarters
- Boat rental company, including kayaks, canoes, wake boards

I think you get the idea — you qualify if you can demonstrate a need for regular communications from your shore station or vehicle to things out there floating on the water. Hopefully, you will see the license is not available for land-to-mobile units that would fall under the business radio rules, and not qualify for eligibility.

You would also not be eligible to talk on a pair of walkie-talkies on shore for hunting, parts delivery, or just gabbing like what ham radio operators do. You would also not be eligible for a marine shore station to talk to any and all other marine shore stations during non-emergencies "just for the fun of it." This is the ham radio service, again.

WHAT FREQUENCIES?

The Federal Communications Commission will usually grant you two or three frequencies PER BAND for your operation. On marine VHF, there are over 78 channels, and you could qualify for three of them:

Channel 16/156.800 MHz simplex
Distress and calling
Channel 9/156.450 MHz
Calling and working
Channel 68/156.425 MHz simplex
Shore-to-recreational boats
Channel 10/156.500 simplex
Shore-to-commercial boats

Coast stations may apply for a data communications license.

Mobile units may qualify for a private coast station license at an *unspecified location*.

Mobile vehicles, as well as airplanes, may qualify for a marine communications license.

Channel 16 and Channel 9 on marine VHF will always be assigned to shore stations, and one or two additional "working frequencies" will be assigned as part of your station license grant. Fifty watts of output power is permitted — and that's double what most marine VHF radios put out!

For long-range communications, a private coast station may be authorized one or two single-sideband frequencies in each of the marine radio bands from 2 MHz to 26 MHz. 2182 KHz — the international distress and calling long-range frequency — shall also be assigned to each private coast station.

Here is what you might be granted for long-range SSB shore-to-ship frequencies:

2182 KHz	Distress and calling
2096.5 KHz	Shore-to-ship, 2A
4146 KHz	Shore-to-ship, 4A
6224 KHz	Shore-to-ship, 6A
8294 KHz	Shore-to-ship, 8A
12353 KHz	Shore-to-ship, 12A
16528 KHz	Shore-to-ship, 16A
18840 KHz	Shore-to-ship, 18A
22159 KHz	Shore-to-ship, 22A
25115 KHz	Shore-to-ship, 25A

The designators "4A," "12A," etc., are the channel numbers that most mariners identify the specific frequency for talking shore-to-ship, and ship-to-shore with their private coast station.

Single-sideband 8A and 12A are the most common long-range channels because the signals may travel up to 2,500 miles away with superb clarity. The emission type is upper sideband, suppressed carrier — identical to what ham operators use on their worldwide bands like 20 meters, 15 meters, and 10 meters. But, unlike ham radio band allocations, marine communications are specific to an exact frequency with frequency error no greater than just a few Hertz.

THE FCC FORM PROCESS

The FCC form to apply for a private coast station license is Form 503 and Form 159. Form 503 is the actual private coast station application, and Form 159 is the remittance fee paperwork. You also need FCC Form 753 which is your personal restricted radio operator's permit.

There are several ways to obtain these FCC forms. One way is to call 800-418-FORM. Another way is to patiently stay on the line after calling 888-CALLFCC. Tell them the three forms you want, and be sure to ask them how much money is required for the Form 503 and Form 753 license grants. Recently, the FCC raised the price of marine radio licensing without any formal public notice, so I suspect that the private coast station may cost around $125.00, and your personal radio operator's permit about $45.00.

You can also try FAXing for Forms 503 and 753 by calling 202-418-0177. You can also try the internet at http://www.fcc.gov. Once you have the required forms, follow the instructions on Form 503, but spend plenty of time explaining your eligibility.

If you run an outboard repair shop next to a busy lake, you will need to completely explain why you need to regularly communicate on VHF with your customers who go out on the lake, and COULD experience outboard motor failure, and COULD need your assistance to tow them back into port. Or, maybe you are with the United States Coast Guard Auxiliary unit, and you need to stay in touch with your shore station as you regularly patrol the river, lake, ocean, or bay.

Or, maybe you are a marine electronics technician, and you need to converse with boats at sea to help diagnose what's wrong with their onboard electronics.

You could carry this one step further and indicate you are the sole proprietor, and you need your station at an unspecified location so you can drive in your car, and still stay in touch with boats up and down the river, or out at sea. This is called a private coast station at an unspecified location. Imagine, 1,000 watts power output, mobile, on worldwide frequencies!

If you live in Southern California or the Pacific Northwest, the Federal Communications Commission will ask you to seek VHF frequency coordination for those VHF channels you are requesting. They will give you the name and address of the local frequency coordinator, and $100.00 later, they will tell you the least busy VHF channels in your area to apply for.

Besides VHF Channels 16 and 9, you should apply for one commercial channel and one recreational channel. In all other parts of the country, you simply state that you have monitored all of the VHF channels, and the two you have picked as working channels are relatively free of nearby base-station users.

AND YOU CANNOT

Your private coast station is not a substitute for ham radio and the capabilities of chat with anyone and everyone. A private coast station requires that you communicate only about ship's business, and not tie up the channels with idle gab. You are also not allowed to talk from shore to a mobile vehicle. You also cannot talk from a shore base station to another base station, except in an emergency. You are also not allowed to place CQ-type general calls where you just want to gab with a radio operator aboard a cruise ship, just for the heck of it. Not allowed. But if you need to transmit your marine business communications to boats at sea, or in the harbor, the private coast station license is just for you.

THE EQUIPMENT

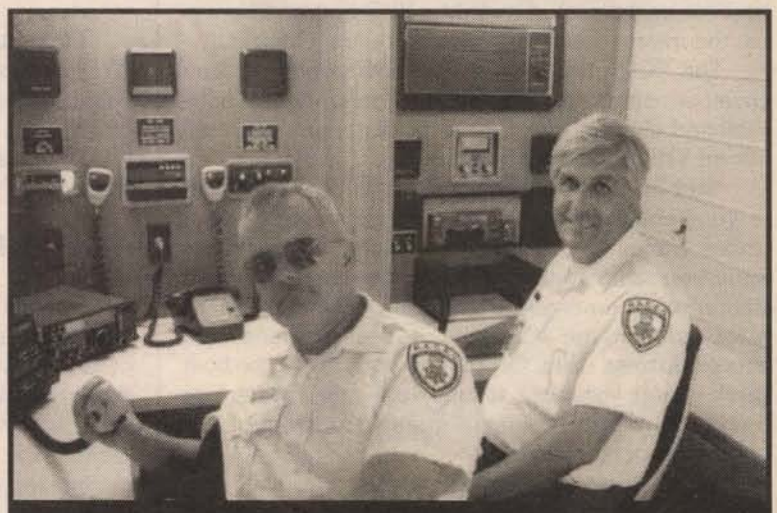
Equipment that carries Part 80 certification will generally meet the type-acceptance standards for use on shore. This means your marine VHF set will probably be a 25-watter (although 50 is permitted) that you would buy down at a local marine store for under $300.00.

For long-range marine single-sideband, you are probably going to spend almost $1,500.00 for a Part 80 type accepted marine SSB. Sorry, a ham set converted over to marine channels doesn't meet Part 80 rules. Your antenna system could be as simple as a little whip for VHF, or a dipole for worldwide. Or maybe you want to go with a log periodic beam on a 50-foot mast atop a 200-foot tower. Your choice. Check your pocketbook first.

BE PREPARED

Finally, once your call letters arrive, don't go on the air until you know exactly what phone number to call in case you should intercept a distress call. Maybe it's going to be to the local park ranger, harbor patrol,

The Everglades have a rescue team with a shore station VHF license to communicate with their air boats.



Private shore stations may be granted to ham or CB radio emergency teams.

or to the United States Coast Guard. Have these phone numbers handy in case you should be the only one receiving a call for help when someone is out there on the water in desperate need of assistance.

Be professional on how you operate over the marine radio airwaves, and welcome to the world of marine single-sideband and marine VHF where there is a license available (without any test) that lets you talk from shore to ships in the bay and ships out on the high seas legally. **NV**

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CODB15S	15 Pin Socket	.45	.43	.39
CODB15PHD	(High Density)	.59	.56	.50
CODB25P	25 Pin Plug	.45	.43	.39
CODB25S	25 Pin Socket	.55	.52	.47
CODB37P	37 Pin Plug	.79	.75	.68
CODB37S	37 Pin Socket	.89	.85	.77
CODB50P	50 Pin Plug	1.19	1.13	1.02
CODB50S	50 Pin Socket	1.29	1.23	1.11

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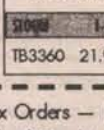

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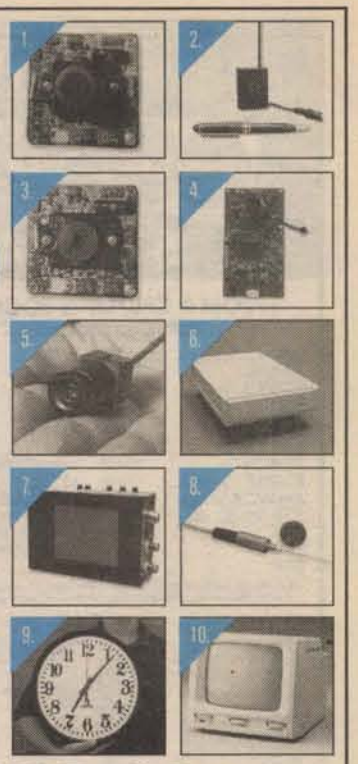

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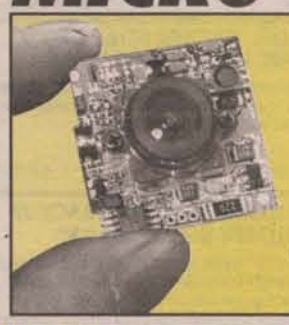
MICRO VIDEO CAMERAS



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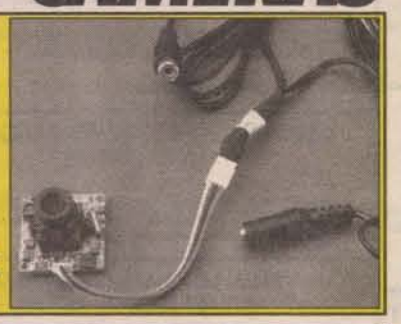

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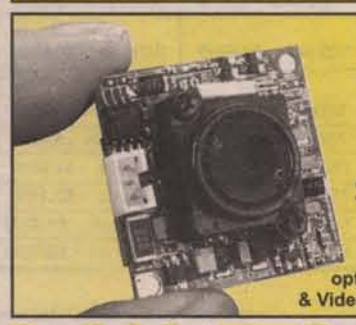

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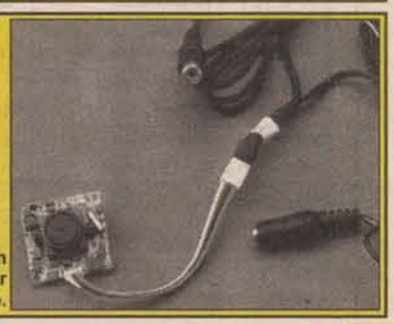

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New retail box Intel math co-processor comes complete with used guide, utility and diagnostic software. Great price and easy installation on upgradable systems. (Chip package 169 pin PGA.) A80487SX ..... $24.95 Ea.

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New Colorado Jumbo 120 tape backup system has up to 120MB capacity using data compression. Installs in minutes connecting to most existing floppy controllers. Includes powerful, easy-to-use Colorado backup for DOS software program. Fits into 5-1/4" or 3-1/2" half height drive bays. QIC-40 compatible. Kit includes: drive, cable, mounting screws, and all documentation. Note: Tape not included.
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(16-Bit ISA Bus Type)
This board is your basic super VGA video board with 1 meg of DRAM type memory. (ISA BUS TYPE.) Core Logic Chip: WD90C31-ZS-00-02. Resolution/Color: 640x480/256C, 800x600/256C, 1024x768/256C, 1024x1024/16C. Note: Software drivers included with board. Windows 3.1, VESA, Autocad, etc.
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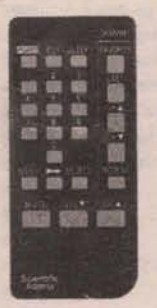

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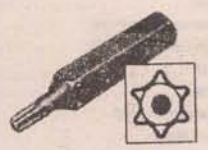

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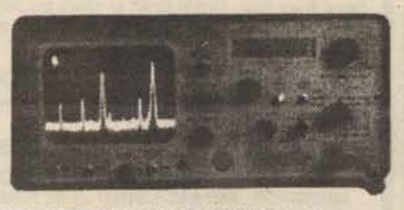

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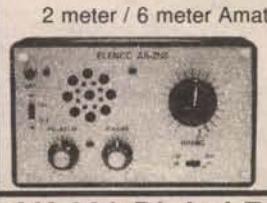

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by Joseph J. Carr, CET
K4IPV

If you "know some smoke" about some area of electronics that others would find interesting, then you might have an article or book in you. Some people claim that writing is a natural talent, but I don't believe it for a minute. I believe that it is a skill that can be developed.

In this article, I provide some guidance on getting published. Keep in mind that these are my opinions, based on my experience, and may or may not represent the opinions of specific editors or publishers.

Slant

Not all articles are suited to all publications. The difference is what the trade calls "slant." This term refers to the point of view taken by the article in reference to the type of readers who buy the magazine. The same topic can sometimes be sold to several different magazines if the slant is different, the timing is different, and the magazines are not generally in competition with each other. Even a cursory look at this magazine shows that it has a readership with a wide range of interests.

The slant is merely your effort to aim the article at the readers of a particular magazine. Every editor can tell you something about his or her readers. You can also get a good idea of the readership by studying recent issues of the magazine. This magazine caters to technically literate ham radio operators, so don't send *Nuts & Volts* an article on ham radio Dxexpeditions or contesting (other magazines use those articles). Although a few editors issue "want lists," most of them will tell you that they don't know what they want "... but I'll recognize it when I see it."

It is difficult to predict what an editor will never want to buy, but there are some guidelines that you can deduce from perusing the magazine content for a few months. Of course, even a "normally no-no" article might find a home if it is uniquely presented, or has a special focus, or is especially well written.

Another "market survey" test is to make sure that the same magazine has not published a similar article in the last couple of years or so. Some magazines will not revisit a topic too closely for as many as five years, so if you find a piece within that time period that is close to your topic, then change the focus or slant of the topic to make it more unique.

Now that you've identified a topic, you sit down and dash it off on the word processor and mail it in, right? No ... not quite yet.

All editors get "over the transom" (unrequested) articles, and will look at them (if they are smart). But editors have one thing in common no matter what the topic or type of magazine: they are very busy people! It takes a lot of time to properly evaluate an article, more time than they may have for months to come.

The way to get the editor's attention is to send a query letter or E-Mail (not all editors like E-Mail queries!). The letter should be short (one page), to the point, tell the editor what the topic is and how you will approach it, and then politely ask for a reply. If you use E-Mail, then make sure the E-Mail address is embedded in the message (not all E-Mail services print the address header).

Does a positive response to a query letter mean that the article is sold? No, not by a long shot. You will still be submitting the piece on speculation. But it does mean that the editor is interested, and that there is a high probability of sale. If you write the article as specified, then it is likely – but not certain – that you will sell it.

Article Format

There are several types of articles that appear in electronics magazines. Some are tutorial pieces, some are experiments or device construction projects, and some are "how-to" pieces.

Let's take a look at the basics of the How-To article. The one common denominator for all How-To articles is that they offer practical instruction and advice. This definition takes in a lot of territory, including most practical technical articles. There is no fixed universal format for all How-To articles, and almost any format will work some of the time.

But there is one format that almost always works, however, so new writers might want to follow it until they get a little experience. That format is called the "Tell-Em-Cubed" method, and follows this outline:

1. Tell them what you're going to tell them.
2. Tell them.
3. Tell them what you told them.

The first "tell them" should be no more than about three paragraphs, and may sometimes occupy only one short paragraph. This "tell them what you're gonna tell them" segment is the preamble that must grab – and hold – the reader's attention and convince him or her to continue reading. The main body of the article is the "tell them" portion and it should occupy the bulk of the space. Finally, we have the "tell them what you told them" section to do a quick (one to three paragraphs) summing up. Use it to highlight the main points, especially those that should be remembered.

For science and technical articles, which are basically "how-to" pieces, there is a modified "Tell-EM" format (which I call the "Tech Writer's Eight-Fold Way"):

1. Tell 'em what you're gonna tell them.
2. Tell what it's gonna do for them.
3. Tell them how it works.
4. Tell them where to get materials and how to build it.
5. Tell them how to test it.
6. Tell them how, when, and where to use it (as appropriate).
7. Tell them how to modify or adapt it for other applications.
8. Tell them what you told them.

Of course, not all of these elements need to be included in every article, but it does represent a stylistic shopping list. Nor is this the only viable format. It is one that usually works well, that's all. If you have another format and want to give it a try, then lots of luck – it could work.

Writing the Piece

Most successful authors prepare at least an informal outline for the article. This road map need not be as formal as one for an English class, but rather it is a guide to ensure that all bases are covered ... and are covered in logical order. The outline is used to keep you on the right track.

Each major topic in your article deserves at least a paragraph. A major mistake made by novice writers is to mix several topics in the same paragraph. If your outline is written to the paragraph level, however, then it is likely that you will not fall into this trap and the article will flow more naturally.

Another common mistake is to include too many topics in the single article. A magazine article is a capsule of information on a specific, usually quite narrow, topic.

How long should the article be? The quick-draw response is "long enough to tell the story," but (while true) that's not the practical answer. Take a look at the articles in your target magazine. Most of them fit into a relatively narrow range of lengths that fits their format. In general, an article should be five to 15 double-spaced, typewritten pages with two to six illustrations. Some magazines publish longer pieces, and certainly some shorter pieces but, in general, those that are bought are in the middle range of sizes. If you really feel strongly that an article needs a long treatment, then write to the editor and make a proposal for either a long article or a multi-part article. If the topic strikes the editor's fancy, then you might get a no-obligation "speculative" go-ahead.

Preparing the Manuscript

When you prepare the manuscript to your article, keep in mind that a real, live, warm-blooded editor must read and work with your piece. With that in mind, prepare the manuscript to make their job easier. I've seen a lot of potential writers over the years who would get fewer rejection slips if they did a better job of preparing the manuscript. If an author is too sloppy to do the mechanical job correctly, then the editor might get the idea that he or she is a little sloppy with the facts as well.

Editors require typewritten manuscripts, so don't even think about sending in a handwritten piece.[1] The typewriter or computer printer should be in good repair, and print well. Dot matrix submissions are accepted by most publishers, but only if they are easily readable. An editor spends a lot of time every day reading, so a washed out, low-resolution dot matrix submission might just go unread. A "near letter quality" printer with a fresh ribbon is the type of dot matrix printer that's acceptable.

The typing should be double-spaced, with one-inch margins all around. Don't attempt to get too much text onto a single sheet. It's false economy, and could cost you the sale. Type the final manuscript on 8.5 x 11 inch plain white 20# paper. Don't use colored paper, or paper with ruling lines on it. Also don't use the "erasable bond" type of paper. The erasable feature is caused by a surface coating that permits the typing to rub off on an editor. Nasty stuff!

The first page of the manuscript should have

(1) The one, lone exception in the entire universe is Forrest Mims III, who has published entire books in his own unique "trademark" handwritten style. Don't you try it, for only Forrest can get away with it!

your name, address, and telephone numbers (with area codes!) in the upper left-hand corner. If you have a facsimile number, then include it as well. Ditto your E-Mail address. The title should be about one-fourth the way down the page, with the byline beneath it. The byline should be written the way you want to see your name in print.

Don't send in a manuscript with a lot of hand corrections on it. In general, professional writers will retype a page if more than three minor corrections appear on it ... and even then only if they use a typewriter instead of a personal computer word processor. Most editors don't mind if someone who uses a typewriter makes a few legible hand corrections, but don't overdo it.

When the manuscript is finished, bind the pages together with a single paper clip, not a staple. Also paper clip the illustrations to the text. In a technical article, the pictures are as much a part of the manuscript as the text, so don't forget them. Send the manuscript flat in a large manila envelope (don't bend it over and force fit it into a standard #10 business envelope). Make sure that there's enough postage to carry it all the way, or it'll come back to you undelivered.

Also, keep in mind that many – maybe most – articles are rejected (even when they are real good). Many editors require a separate self-addressed stamped manila envelope so they can return the piece to you.

Illustrations

"A picture is worth a thousand words," says an old cliché. That old saw might be true in some cases, but when you are being paid on a page-rate basis a picture is worth more like 200 words. The real value of the picture, however, is that it enhances the article and makes it easier to follow. In fact, for technical articles the picture might make it possible in the first place. A picture, in that case, isn't worth a thousand words ... it's priceless.

For some magazines, you will not have to professionally draw the illustrations for your pictures. Pencil drawings are acceptable to many magazine editors, but they have to be done in a way that can be interpreted by the magazine's artist. Most magazines do not have on-staff artists, so they want to see "camera ready" illustrations. You can do these with pen and ink, but only if they are very well drawn.

If you have a computer drawing software package available, then use it. I use Visio Technical 4.1 for my work. In many cases, the editor can use the artwork as "camera ready" and that saves money ... which makes your article more valuable to them. If you use a drawing package, however, make sure that you set all lines to three pixel size, and don't use less than nine point type. Smaller type and thinner lines are hard to reproduce in a magazine (in fact, they are often impossible!). The graphics files that you create should be provided to the editor. Most editors can use either encapsulated postscript (*.eps) or tag imaged file (*.tif) files. However, I've notice that *.eps files often cannot be read by others (they turn out all black).

Photographs are also very useful for illustrating the technical article. There are some general guidelines for making photos. Do not use the low-cost 110, 126, or disk format films. Use 35 mm or larger (e.g., 120 or 220 size) film for your photos, even if you have to borrow a camera. If you are submitting black & white photos, use film such as T-Max, Verichrome Pan, Panatomic-X, Plus-X, Tri-X, or their equivalents.

Use color print film unless an editor specifically requires black & white prints only. Slides can sometimes be used by some magazines, but check with the editor before you hang your piece on a color transparency. A photo laboratory can make a B&W print from your slide by shooting a B&W internegative from your transparency, if only black & white is acceptable.

The print should be glossy, and be either 4x5 or 5x7 size. Place your photo in a celluloid "page protector" (available at office supplies stores for about 50 cents). Tape the photo to the inside paper in a way that keeps the tape off the print or have borders placed on the print. You have to request this, though, from the lab.

Captions

If you want to hear an editor scream bloody murder, then submit a heavily-illustrated article without a list of captions. The editor can't write the captions as good as the author, if only from lack of familiarity, unless he or she spends a lot of time to ferret the details out of the text. The captions should be typed on a separate sheet of paper and clearly marked as to what caption goes with what illustration.

Electronic Submissions

Personal computers are a fact of life today, and in the magazine business that goes double. In fact, magazines were among the earliest large scale users of computers because of page layout programs and electronic typesetting. When I submit an article, I send an IBM-formatted 3.5-inch 1.44-mbyte diskette with two text files on it for articles, and an Iomega ZIP cartridge or CD-ROM for books. I also submit both Word-97 and ASCII text files. If the editor can use graphics files, then I also put those on it.

Certified Electronics Technician (CET) Program

Recently, I completed a study guide for the Certified Electronics Technician (CET) program. It will be published by Howard W. Sams/PROMPT Publishing later this year. The CET program got started in 1965, and is run by the International Society of Certified Electronics Technicians (ISCET). It provides a means for you to certify your electronics knowledge in certain fields and receive a credential for the effort. A number of employers will select a CET over another equally qualified applicant because the CET is more of a known entity.

The CET examination comes in two levels. The Associate level is open to people with less than four years experience in electronics. The examination consists of 75 questions on basic electronics. The Journeyman level examination consists of another 75-question examination, and requires four or more years of experience. The Journeyman level examination is customized to specific areas of electronics technology (e.g., consumer electronics, communications, biomedical electronics). For more information on the exams, where they are given, and the cost, contact ISCET at:

ISCET
2708 West Berry Street
Fort Worth, TX 76109
(817) 921-9101 (Voice)
(817) 921-3741 (FAX)

If you have access to the World Wide Web, then simply type "ISCET" into your search engine and you will find several sites (including ISCET's own site). **NV**

Much of this column was developed from a book I am writing for academics and professional people titled Publish, Don't Perish, and a workshop presentation of the same title I give to college faculties and professional groups.

Connections ...
I can be reached at P.O. Box 1099, Falls Church, VA 22041, or via E-Mail at carrjj@aol.com

Test Your "EIQ"

Let's take a little test of your basic electronics technology knowledge. I call it "Electronics Information Quotient" or EIQ. Try to answer the questions below before looking at the answer and discussion.

1. In Figure 1, resistance R1 is the internal resistance of the voltage source. At what resistance does resistor R2 dissipate the greatest amount of power?

Discussion: The maximum power transfer between a source and a load occurs when the load resistance matches the source resistance. In other words, maximum power transfer occurs when R2 = R2 = 100 ohms. P = E2/R = E2/(R1+R2) = (12-V)2/(200-ohms) = 144/200 = 0.72 watts. The efficiency of the circuit when maximum power transfer occurs in 50 percent because half the power is dissipated in R1 and half in R2.

2. What will meter M1 in Figure 1 read when R2 = 200 ohms?

Discussion: The current is found by Ohms Law, I = E/R, in which R is the series combination R1 + R2.

3. What is the total capacitance seen by the generator in Figure 2?

Discussion: Capacitors in series combine like resistors in parallel. Therefore, because only two capacitors are involved, we can use the formula below:

$$C_T = \frac{C1 \times C2}{C1 + C2} = \frac{0.001 - \mu F \times 0.005 - \mu F}{0.001 - \mu F + 0.005 - \mu F} = \frac{0.000005}{0.006} = 0.00083 - \mu F$$

4. In Figure 2, the generator frequency decreases from 15 KHz to 8 KHz. What will happen to the voltage drop across capacitor C2?

Discussion: Because two capacitors are in series, and both are affected by the change in frequency, the ratio of their reactances remains constant, even though the actual values of the reactances change with the applied frequency

Answers

1. 100 ohms
2. 0.04 A or 40 mA
3. 0.00083 uF
4. It will remain unchanged.

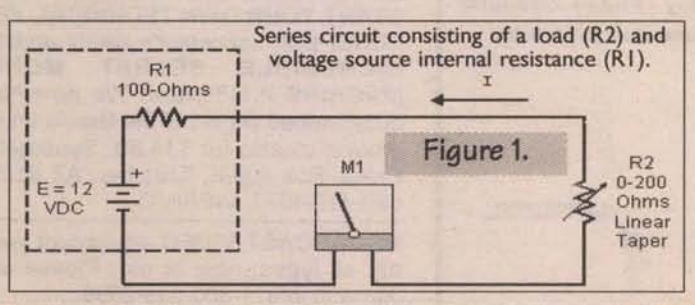

Figure 1.

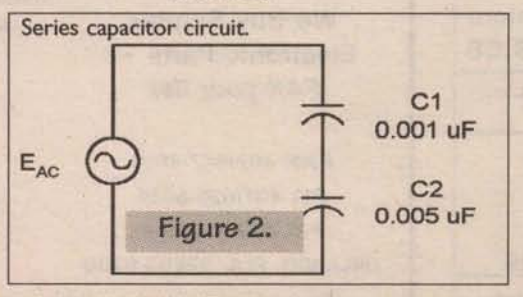

Figure 2.

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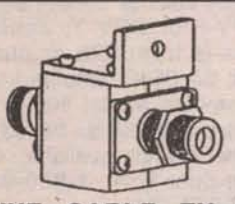

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Mfg. suggested list price $729.95/**Special $319.95**
300 Channels • 10 banks • Built-in CTCSS • S Meter
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Frequency Coverage: 29.000-54.000 MHz., 108.000-174 MHz., 216.000-512.000 MHz., 806.000-823.995 MHz., 849.0125–868.995 MHz., 894.0125-956.000 MHz.

The Bearcat 895XLT is superb for intercepting trunked communications transmissions (see BC235XLT description) with features like TurboScan™ to search VHF channels at 100 steps per second. This base and mobile scanner is also ideal for intelligence professionals because it has a Signal Strength Meter, RS232C Port to allow computer-control of your scanner via optional hardware and 30 trunking channel indicator annunciators to show you real-time trunking activity for an entire trunking system. Other features include ***Auto Store*** – Automatically stores all active frequencies within the specified bank(s). ***Auto Recording*** – This feature lets you record channel activity from the scanner onto a tape recorder. ***CTCSS Tone Board*** (Continuous Tone Control Squelch System) which allows the squelch to be broken during scanning only when a correct CTCSS tone is received. For maximum scanning enjoyment, order the following optional accessories: **PS001** Cigarette lighter power cord for temporary operation from your vehicle's cigarette lighter $14.95; **PS002** DC power cord - enables permanent operation from your vehicle's fuse box $14.95; **MB001** Mobile mounting bracket $14.95; **EX711** External speaker with mounting bracket & 10 feet of cable with plug attached $19.95. The BC895XLT comes with AC adapter, telescopic antenna, owner's manual and one year limited Uniden warranty.

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Mfg. suggested list price $699.95/**Special $329.95**
FREE - Get an extra BP2500 battery pack, a $51.95 value when you order a Bearcat 3000XLT. Hurry...offer expires 4/30/98.
400 Channels • 20 banks • Twin Turbo Search/Scan
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Frequency Coverage:
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TrunkTracking Radio

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Bearcat®235XLT-A TrunkTracker

Mfg. suggested list price $429.95/**CEI price $269.95**
300 Channels • 10 banks • Trunk Scan and Scan Lists
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10 Priority Channels • Programmed Service Search
Size: 2-1/2" Wide x 1-3/4" Deep x 6" High
Frequency Coverage:
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Questions & Answers
TECH FORUM

This is a READER TO READER Column. All questions AND answers will be provided by *Nuts & Volts readers* and are intended to promote the exchange of ideas and provide assistance for solving problems of a technical nature. All questions submitted are subject to editing and will be published on a space available basis if deemed suitable to the publisher. All answers are submitted by readers and *NO GUARANTEES WHATSOEVER* are made by the publisher. The implementation of any answer printed in this column may require varying degrees of technical experience and should only be attempted by qualified individuals. Always use common sense and good judgement!

QUESTIONS

I'm interested in building a low-speed, low-cost way to send data via RF. Any suggestions?

2981 **Peter Douma**
Wyckoff, NJ

I am looking for stand-alone telephone logger which would connect to the line, detect pick-up of any telephone extension, record the DTMF dialed, detect hang-up, and record duration of the call. Ideally, it would also detect connection and hang-up of the other party. Output could be either to a stand-alone printer or preferably by offline download to a PC program.

2982 **M. Feder**

I have a non-linear systems 4-1/2 digit LED PC-4 event counter that I bought at least 15 years ago, but never used. I now have an application, but I can't find the data sheet.

The counter uses a Mostek MK5002 and four 4049, plus a few transistors and a few other components.

The PC traces are brought out to an edge connector. I need to know the function of the edge connector contacts.

2983 **Gene Riding**
San Diego, CA

How are bipolar electrolytic capacitors made? I saw a schematic once and I thought "how clever." It must have been, because now I can't remember it. As I recall, two caps are used back-to-back, six diodes steer the current, and one cap always ends up reverse-biased by one to two diode drops.

2984 **Daniel C. Gates**
Wichita, KS

If you have any ideas to the following, it would be a great help. I have a Sound Blaster daughter card called the Wave Blaster. It is an eariler wavetable synthesis card with software by Eu systems. Is there any way I can utilize this card as a stand-alone connecting a midi keyboard to it?

2985 **Glick Nicklenorp**
via Internet

I need some information about a Toslink TOTX173 data sheet, specs, etc. I am trying to connect it to a Toshiba CD-ROM to get an optical line.

Please visit http://members.tripod.com/~Psych/md-cdrom.html to see what I am taking about. This page explains in detail what I am trying to do. I hope that someone can please help me to figure out how to actually complete the procedure.

2986 **Mario**
via Internet

I need to find the pinout for INTECH VDAC 1842N. It is a video dac vintage 1988 from the date code. The company no longer exists.

2987 **Lawrence Mertz**
Palo Alto, CA

I think I read many years ago that TV stations broadcast a supersonic carrier during commercials. Is this true? I would like to develop an automatic mute system.

2988 **Ralph Condit**
Dearborn, MI

What DOS command or program would you use to format a 3-1/2" disk when you receive the following message:

INVALID MEDIA OR TRACK 0 BAD - DISK UNUSABLE. FORMAT TERMINATED, FORMAT ANOTHER (Y/N).

There must be a way to format the disk because the disks are not manufactured formatted. They must be formatted after assembly.

2989 **Thomas Andras**
Holly, MI

I need a simple circuit to change printer serial output to parallel output. (9600 Baud serial).

29810 **Terry Laraway**
Bremerton, WA

Does anyone know of a way to make a frequency meter (60 Hz) using an analog meter base?

29811 **Robert Eshoo**
Santa Monica, CA

I have a question about dropping 12-volts DC down to 7.2 or 7.5.

I have a video camera that needs 7.2 (or 7.5, but no more than 8 so 7.5 max).

I have the batteries that go with the camera, but if we use the zoom, we only get about 30 minutes on them. So, I bought a device that would let me run the camera from the car, just plug it into the car and the other end went to the camera, only instead of using a 12-volt car battery, I use a 12-volt motorcycle battery.

This worked great for years, then one day the camera didn't work. It cost me over $200.00 to have it fixed.

When it came back, there was a note with it saying there was an over-voltage problem. So I checked the voltage out of the dropping device, sure enough, instead of 7.2 volts, it was 12 volts.

Well at the time, I didn't know what was in the black plastic case, so I took it apart with a hammer, there are six 1N 5400 diodes in series, that is all. I looked them up, each has a voltage drop of .9 volts. Well, I can put six diodes in series, but to be on the safe side, so I am sure this never happens again, I want to use a zener diode rated at 7.2 or 7.5 volts at 3 amps.

My question is where should I put the zener diode? In series on the end after the other diodes, the zener diode to camera, or 12V DC to camera. Does the zener diode go in series, like above? Or is it in parallel with the battery voltage? Or should I just forget about the diodes and use only a zener diode, or should the zener go between the (from one to the other) wires that go to the camera? I can make one of these for about $4.00 and save $65.00 if I can find out where to put the zener?

29812 **Lee Walter**
via Internet

Does anyone know how you would go about making an attachment that would go on a DMM to measure induction? Or how you would make a meter to measure induction?

29813 **Gregg Berkholtz**
via Internet

I purchased two notebook computers at an auction. After several hours of work, I managed to get both to start to boot, except they both ask for a password before I can access the BIOS. One is a Toshiba satellite 105C, the other is CTX EZbook 486DX75. I have tried disabling the BIOS battery and I cannot find a jumper like on a desktop. So what do I need to do to remove the password?

29814 **Doug Branch**
Nineveh, IN

ANSWER INFO

- Include the question number that appears directly below the question you are responding to.
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1) Circuit Design 3) Problem Solving
2) Electronic Theory 4) Other Similar Topics

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- Be brief but include all pertinent information. If no one knows what you're asking, you won't get any response (and we probably won't print it either).
- Write legibly (or type). If we can't read it, we'll throw it away.
- Include your Name, Address and Phone Number. Only your name will be published with the question, but we may need to contact you.

ANSWERS

ANSWER TO #1981 - JAN. 1998

I had a similar problem. Unfortunately, I didn't solve the problem. But I did find out what caused the problem and what you may try.

I suspect your "printer port" is reacting to the binary data you are sending. You may be able to temporarily disable your printer port from interpreting the data (pretend you are sending a graphic to the printer).

Look at the printer port options of the BIOS commands.

Another solution is to use the serial port instead of the printer port. You can do hardware handshaking with the serial port (all data is passed).

The reason you are having your problem is described below.

Continued on page 108

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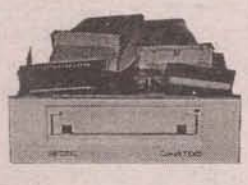

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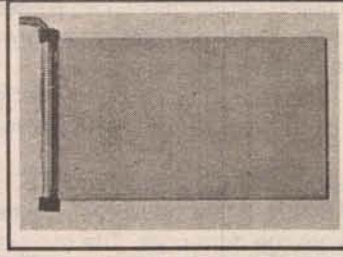

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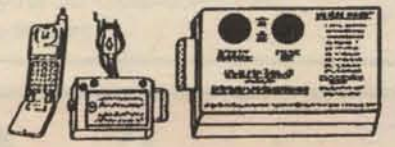

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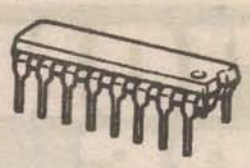

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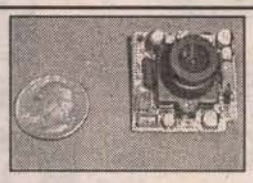

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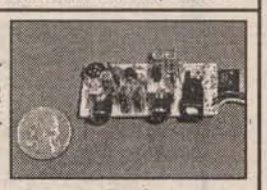

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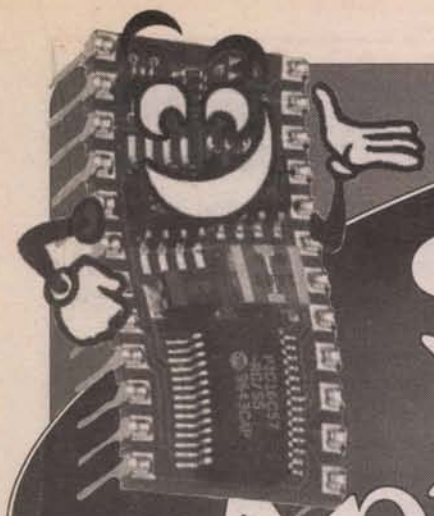

Stamp Applications:

Putting the Spotlight on BASIC Stamp Projects, Hints, and Tips

by John Barrowman, Jeff Martin, and Ken Gracey

Have you ever wondered what Stamp topics Parallax technical support staff would discuss if given an opportunity to write a column for *Nuts & Volts*? How about synthesizing a real-time clock, floating point math simulation, and counting pulses on multiple I/O pins. These are Jeff and John's "Advanced Stamp Programming Techniques," named because they should provide a basis for more complex programming.

REAL-TIME CLOCK WITH USER INPUTS

The BASIC Stamp doesn't have a real-time clock, and implementing a real-time clock is often done with external clocks from Dallas Semiconductor or Solutions Cubed. This example shows how to use four discrete registers and the PAUSE command to implement a real-time clock in PBASIC. A real-time PBASIC clock works well if the Stamp can be calibrated to a reliable source.

The timing is adjusted by using the BASIC Stamp II's PAUSE command — a PBASIC instruction that causes a delay for x milliseconds. The variable must be 16 bits or smaller (less than 65535). The example program begins by pausing 985 milliseconds (almost a second) since the rest of the program takes 15 milliseconds to execute. Time is displayed on a Scott Edwards serial LCD using the SEROUT command from pin 0. If you don't own an LCD display, simply replace the SEROUT instruction with DEBUG and the time will be displayed on your computer screen.

The PAUSE command buys the time you need to insert additional PBASIC code and use the additional EEPROM space for other tasks. The Stamp II executes about 4,000 instructions per second, theoretically, an additional 400 lines of code could be executed in 100 milliseconds (less than the 985-millisecond delay). If you add code, you will have to decrease PAUSE to ensure the Stamp is still being a reliable clock. To ensure consistent operation, be sure each iteration of your added code takes the same amount of time to execute.

Now it's all up to you to add features to the sample. Try using pushbuttons to adjust the time, or modify the program to receive a serial message containing the current time before proceeding. Try to collect time-stamped data from the Dallas Semiconductor 1620 digital thermometer.

See TIME.BS2 on next page.

ALGEBRAIC TRICKS WITH THE BASIC STAMP

Simple Floating Point Math Solution

BASIC Stamps work only with integer math, which means that no fractions are allowed and decimal results are truncated. Expressions and results are presented as integers and the remainder is simply lost. This means the Stamp does not support floating-point math. However, with a few algebraic tricks and additional variables, you can easily achieve simple floating-point math.

For example, let's assume you want to calculate and display a number from 0.0 to 100.0, and this number results from the expression X = A / B. A is any number from 0 to 1900, and B is any number from 20 to 160. If A = 1326 and B = 85, the equation result should be 15.6 based on the number of significant digits. The Stamp would return a number of 15.

There's a way to work around this. The decimal point can be moved one position to the right by multiplying one multiplicand by 10 before executing the equation. For example:

(A)/(B)=(X) is the same as (A)(10)/(B)=(X)/10
because the 10s cancel each other.

And with actual numbers:

(1326)/(85) = (15.6) is the same as
(1326)(10)/(85)=(156)/(10)

However, the Stamp cannot perform the last division by 10 without truncating the number to 15. We can perform the last division logically when we display the number. In other words, we will use the equation:

(A)(10)/(B) = (X)

Here's the source code:

```
' Tenths.BS2
' Jeff Martin, Parallax Technical Support Engineer
' Stamp Applications: Nuts and Volts February 1998
' First, set up our variables
A       VAR     WORD
B       VAR     WORD
X       VAR     WORD

'Initialize the values
A = 1326
B = 85

'Now do our modified calculation
'(multiply the first number by 10) then divide
X = A*10 / B

'Now display it on the PC screen
DEBUG DEC X/10, ".", DEC X DIG 0
```

The last line of code with DEBUG is where we pull the last trick. It displays "15.6" on the PC screen. First, it displays the integer portion of the number by dividing it by 10: DEC X/10. Second, it places a decimal point on the screen: ".". And third, it uses the handy DIG operator to grab a single digit — the ones-place digit — from the number and display it: DEC X DIG 0. It is important to note that we still cannot exceed the maximum size for a number at any time during the calculation. The part we need to worry about is the A*10 operation. Since we can only hold a number up to 65535, this operation limits us to a maximum "A" value of 6553 since 6553 * 10 = 65530.

So you've mastered simple floating point math, but what if you don't care about the fractional portion of a result, but you need to multiply a variable by a floating point number? For example, X = A * 4.35 where A is a number from 52 to 196. The Stamp does not understand the number 4.35 in the equation.

Your first thought may be to use a variation of the first trick, to multiply the floating point constant by 100, evaluate the expression, and then treat the right-most two digits of the result as the fractional portion (which we don't care about). This seems to work:

A*4.35=X is the same as: A*(4.35*100)=X/100

Since we are not concerned about the fraction in the result, the Stamp can feel free to truncate the fraction in the result. Now the equation is

X=A*(4.35*100)/100 or X=A*435/100

If A is 52, the expression results in 226 (exactly what we expect). If A is 196, the expression results in 197 (we expected 852). So what happened? Unfortunately, 196*435=85260, which is much larger than the Stamp's 16-bit space, and so the result returned is wrong. The largest number the Stamp can handle is 65535.

Multiplying a Variable by a Known Fraction Using */

If you'd like to multiply a number by a known fraction, there's a little known and often misunderstood operator in the BS2-IC that can save the day. It is called the "star slash" operator ("*/"). The */ operator works with a 16-bit space, but it treats it as an eight-bit integer and eight-bit fraction. This accuracy works in most cases, even though it is not absolute.

Using the above floating point example of 4.35, we will convert the number on each side of the decimal point — the 4 and the .35 — into the proper 16-bit form. This needs to be done before writing the expression code in PBASIC.

The equation for handling this is the following

Converted Number = INT (INT(number) * 256 + FRAC(number) * 256) and working through this

```
=   INT ( INT(4.35) * 256 + FRAC(4.35) * 256 )
=   INT (4 *  256 + .35 *  256 )
=   INT (1024 + 89.6)
=   INT (1113.6)
=   1113
```

The final number looks strange, but the BS2-IC's */ operator translates the number to 4.34765625, very close to 4.35. Here's the source code which displays the number we expect to be debugged to your PC screen using the */ operator.

```
' starslsh.BS2
' Jeff Martin, Parallax Technical Support Engineer
' Stamp Applications: Nuts and Volts February 1998
' First, set up our variables
A       VAR     WORD
X       VAR     WORD

'Initialize the value
A = 52

'Now do our modified calculation, multiply by 4.35
'with the */ operator
X = A */ 1113

'Now display it on the PC screen and move to the
'next line
DEBUG DEC A," * 4.35 = ",DEC X,CR

'Now let's try one more time
A = 196

X = A */ 1113

DEBUG DEC A," * 4.35 = ",DEC X
```

In case you are wondering, the fractional portion of the floating point number is expressed internally as 89/256 = 0.34765625. Combined with the integer portion, it is 4 89/256 or 1113/256. If you used a calculator and multiply this into 196 as in 196*1113/256, you'll end up with 852.14. This is exactly what the */ operator does, except that it truncates the fractional portion. Hence the name. First, it multiplies using * and divides using the /. Again, you might notice that 196*1113 results in a number much greater than 16 bits wide. The */ operator keeps track of the intermediate result in 32 bits, then divides by 256 (discarding the first eight bits) and truncating off the upper eight bits, leaving a nice 16-bit number.

SIMULTANEOUSLY COUNTING PULSES

The Stamp's COUNT function counts cycles on a pin for x milliseconds. This works well if the Stamp has nothing else to do but wait for a pulse on a pin, but what if you need to count pulse transitions on multiple I/O pins while other code is executing using minimal code space? Using logic statements and storing pin transitions lets the Stamp count pulses on more than one pin.

This project was developed on the BASIC Stamp Activity Board with "pluggable jumpers" and a Scott Edwards 2x16 Serial LCD display. John and Jeff use these tools to expedite a quick project or simulate a customer's application over the telephone. If you don't have a serial LCD, replace the SEROUT with DEBUG to send the results to your PC screen and remove the "low 0" instruction since the display I/O is not used. You'll need the BASIC Stamp Activity Board unless you have a few pushbuttons and resistors to simulate the board's predetermined circuitry.

The program begins by defining the variables. The display I/O pin and variables are then initialized. The START subroutine reads the status of two I/O pins, then calculates and adds the transitions only. The results are stored in two new registers and the data is written to a display. If P10 is grounded (button depressed), then the registers are cleared. The program repeats itself in an endless loop.

Like the real-time clock example, this project also provides the Stamp room for additional tasks. By placing additional source code before or after the SEROUT instruction, the Stamp can handle additional tasks while counting pulses. We'll leave this project up to you, but remember that the maximum count rates depend on the overall execution of one loop iteration. It isn't possible to press the BASIC Stamp Activity Board's buttons quicker than the one loop of PBASIC code is executed, so you could combine this project with the floating point math simulation described above. **NV**

Sources

For more information on the BASIC Stamp, contact:

Parallax, Inc.
3805 Atherton Road, #102, Rocklin, CA 95765
phone **(916) 624-8333**
Internet **http://www.parallaxinc.com**

Scott Edwards Electronics
P.O. Box 160, Sierra Vista, AZ 85636-0160
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Internet archive *(catalog, user manuals, samples)* located at **ftp.nutsvolts.com** in directory **/pub/nutsvolts/scott**
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Tyler, TX 75703
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jonwms@aol.com
Internet: **http://members.aol.com/jonwms**
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```
' TIME.BS2
' John Barrowman, Parallax Technical Support Engineer
' Stamp Applications: Nuts and Volts February 1998
' This program demonstrates how to implement a real-time clock on the Basic
' Stamp. Time is metered using the PAUSE command. Seconds, minutes, hours,
' and the AM/PM status are stored in discreet registers.  This program uses
' a 2x16 Scott Edwards LCD Display to show the formatted time.

Baud    con     $4054                   ' 9600, N,8,1 (Inverted Data)
hrs     var     byte                    ' Holds the Hours part of time
mns     var     byte                    ' Holds the Minutes part of time
sec     var     byte                    ' Holds the Seconds part of time
ampm    var     bit                     ' Keeps track of night and day.

INIT
    pause 500                           ' Must wait for display to power up
    serout 0,Baud,[254,2,"  Current Time"]       ' Write header

START
    pause 985                           ' Adjust this to 'tune' the clock.
    serout 0,Baud,[254,175,"  ",dec2 hrs,":",dec2 mns,":",dec2 sec]
    if ampm = 1 then PRN_AM  ' After writing the time determine
    serout 0,Baud,["  pm"]      ' AM/PM status and write to display.
    goto INC_TIME
PRN_AM
    serout 0,Baud,["  am"]

INC_TIME
                                ' Every iteration of the loop should
    sec = sec + 1               ' take exactly one second.  So, we'll
    if sec < 60 then START      ' increment the seconds register each
    sec = 0                     ' iteration.  If the seconds register
    mns = mns + 1               ' overflows (>59), we must: clear it,
    if mns < 60 then START      ' increment the minutes register, and
    mns = 0                     ' check the minutes register for over
    hrs = hrs + 1               ' flow. If the minutes register over-
    if hrs <> 12 then ROLL      ' flows, we must clear it then incre-
    ampm = ampm ^ 1             ' ment the hours register. And so on.

ROLL
    if hrs < 13 then START
    hrs = 1
    goto START
```

```
' COUNTS.BS2
' John Barrowman, Parallax Technical Support Engineer
' Stamp Applications: Nuts and Volts February 1998
' This program demonstrates a way to count pulses when the count function
' is not appropriate. Pulse transistions are counted on pins 8 and 9 use-
' ing calculations instead of logic statements. This minimizes code space
' used and reduces the execution time. This program writes the results to
' a 2*16 Scott Edwards LCD Display. This project was developed on the new
' Basic Stamp Activity Board. On the BSAC board, inputs pins P8-P11 are
' pulled high and grounded when the pushbuttons are pressed. Pressing the
' button connected to P10 results in clearing the counter registers.

Baud    con     $4054           ' 9600, N,8,1 (Inverted Data)
xctr    var     byte            ' Holds the #transitions on P8.
yctr    var     byte            ' Holds the #transitions on P9.
xprev   var     bit             ' Holds the previous state of P8.
yprev   var     bit             ' Holds the previous state of P9.
xcurr   var     bit             ' Holds the current state of P8.
ycurr   var     bit             ' Holds the current state of P9.

INIT
        low 0                   ' Initialize the display I/O line.
        xctr = 0                ' Initialize all variables.
        yctr = 0
        xcurr = in8
        xprev = xcurr
        ycurr = in9
        yprev = ycurr
START
        xcurr = in8                                 ' Read input pins.
        ycurr = in9
        xctr = xctr + (xcurr ^ xprev & xprev)       ' Calculate and add
        yctr = yctr + (ycurr ^ yprev & ycurr)               ' transitions only.
        xprev = xcurr                                       ' Update the 'prev'
        yprev = ycurr                                       ' registers.
        serout 0,Baud,[254,  2,"X Counts: ",dec3 xctr]      ' Write data to the
        serout 0,Baud,[254,175,"Y Counts: ",dec3 yctr]      ' display
        if in10 = 1 then START                      ' If P10 is grounded
        xctr = 0                                    ' then clear the
        yctr = 0                                    ' count regisers.
        goto START                                  ' Repeat forever.

' Please note that the calculations for XCTR and YCTR are different. XCTR
' is counting the negative transitions, and YCTR is counting the positive
' transitions. This is deliberate to exemplify both techniques.
```

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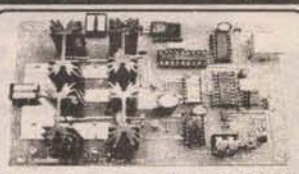

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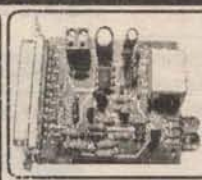

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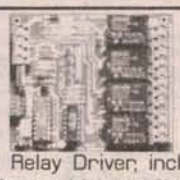

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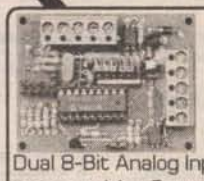

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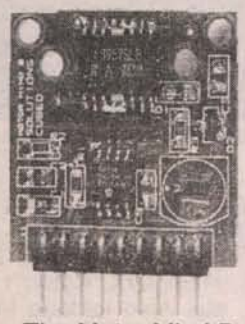

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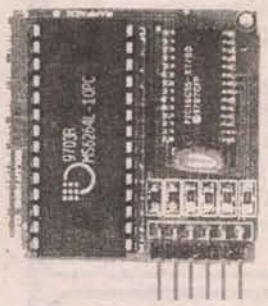

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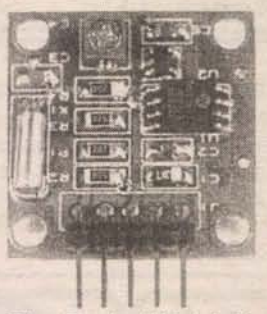

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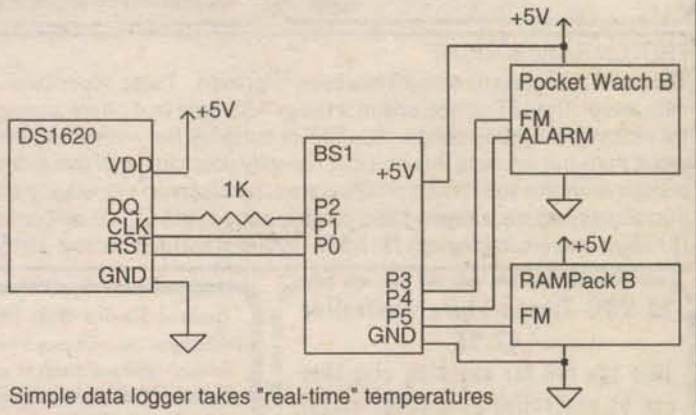

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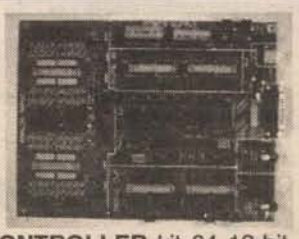

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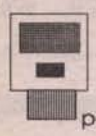

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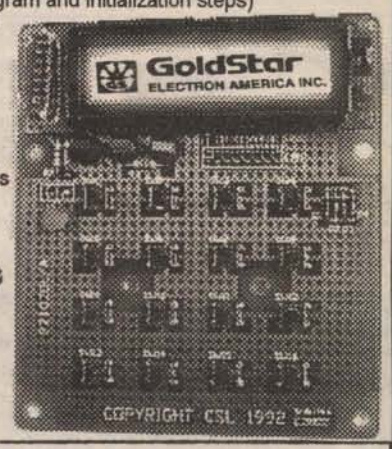

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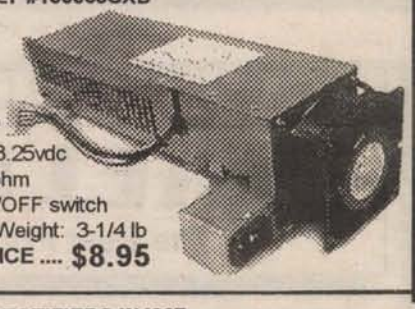

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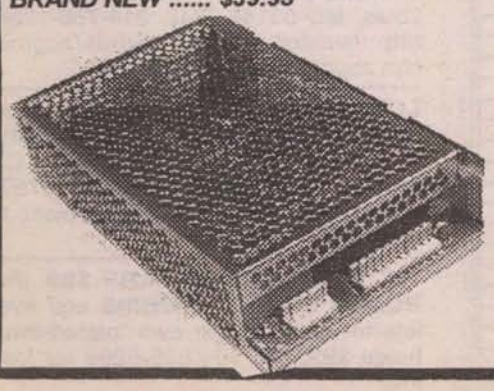

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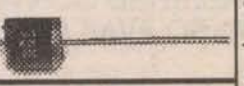

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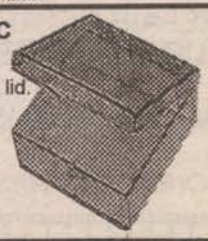

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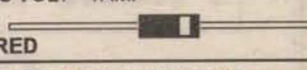

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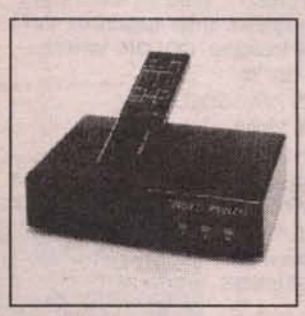

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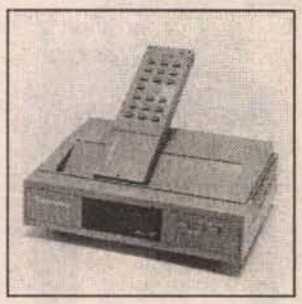

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ROBOTICS *cont.*

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ELECTRONICS Q & A

With TJ Byers

In this column, I answer questions about all aspects of electronics, including computer hardware and software. This column doesn't replace the Tech Forum that you've grown to love and support. Instead, it will supplement it, so feel free to participate as always with your questions and answers. You can reach me on America Online at TJBYERS, on the Internet at TJBYERS@aol.com or by snail mail at *Nuts & Volts Magazine, 430 Princeland Ct., Corona, CA 91719.*

What's Up:

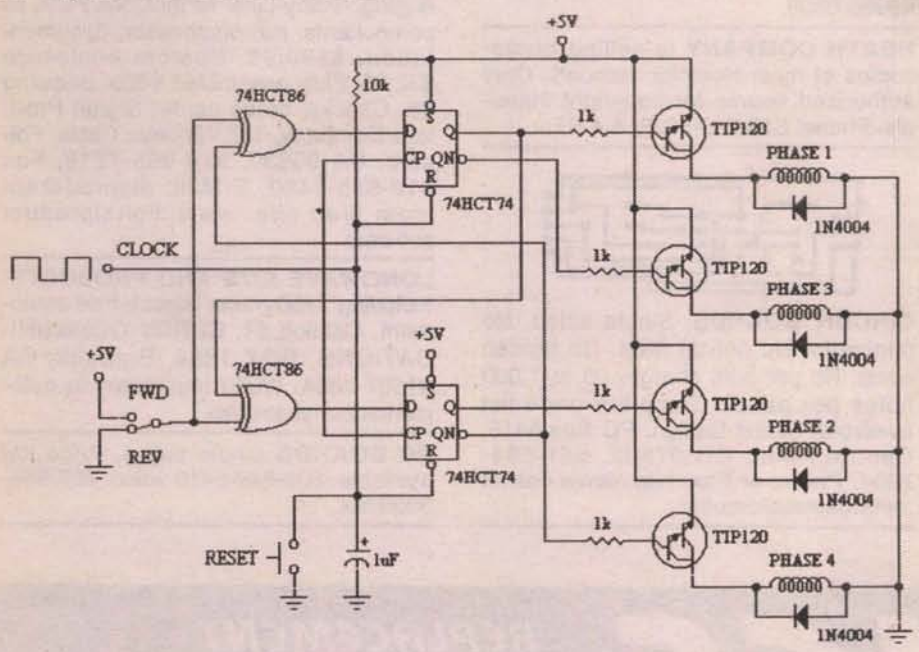
Space-age technology reaches earth, how to let your sound card eavesdrop on phone conversations, quieting amplifier noise, and counting cars. On the PC front, we look at two upgrade problems and go in search of the perfect PIC book.

Space-Age Stepper Motor Controller

Q. I have two bipolar, four-wire stepper motors with an integrated gear drive that are installed in a pan/tilt mechanism. Is there a no-frills way of making these motors go? All I want to do is rotate them at any speed, and be able to reverse their direction using paddle switches.

Jack Shubert
via Internet

A. *Try the circuit shown below.*



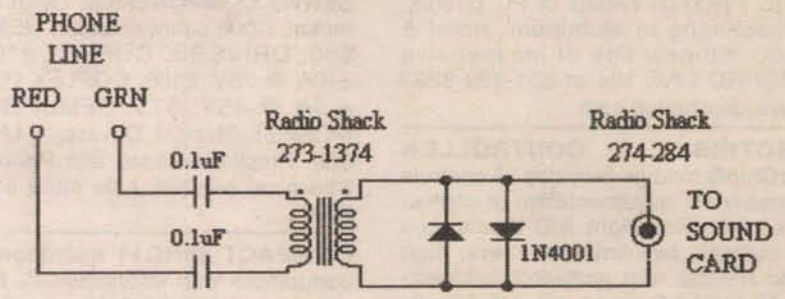
This simple stepper controller was invented by JPL, the same people who put the Sojourner robot on Mars. Unlike most stepper motor controllers, it doesn't require a computer, microcontroller, or look-up table (EPROM). Instead it uses a couple flip-flops and two XOR (exclusive OR) gates. The stepper motor coils are driven by four Darlington transistors. The rotational speed of the motor is determined by the pulse rate of the CLOCK input (this clock pulse can be easily generated using a 555 timer), and the rotational direction is controlled by a single toggle switch.

SoundBlaster Phone Monitor

Q. In your Jan. '98 column, you show a circuit to record telephone conversations on a tape recorder by connecting the MIC input to the red and green phone lines. I've heard that when the phone rings, the voltage across these wires can reach 100 volts. Could this harm the tape recorder? What modifications do I have to make to plug it into a SoundBlaster sound card?

Andy Jennings
Arizona State University

A. *The 100K resistor and .01 uF capacitor provide enough resistance to the 20-Hz ringer signal that the tape recorder never sees more than 1 volt when the phone rings. When connecting the phone line to a sound card though, I'd use the following circuit.*



For safety's sake, a transformer isolates the sound card from the phone line. The capacitors prevent the transformer from triggering the phone line off-hook, and the diodes clamp the input voltage to 0.7 volts so that the ringer signal won't blow out the sound card's input. Notice that the phone signal is mono and the plug specified is stereo – as is the sound card's input. If you want the sound to come from both speakers, wire the inputs of the stereo plug together

Driveway Sensor

Q. I would like to make a driveway sensor (possibly inductive) that's similar to the ones used at traffic lights. I have used IR sensors in the past, but they sense every bird and deer in the neighborhood and loose sensitivity after a few months of use. The sensor will be placed about 150 feet from my house, and I don't need another mortgage so it has to be cheap and simple.

Ron Gaspar
via Internet

A. *The transportation industry is moving from inductive sensors to more sophisticated sonic (sonar-like) and piezoelectric (pressure) sensors. They*

are more accurate and can be installed without tearing up the pavement. From time to time places like All Electronics (800-826-5432; http://www.allcorp.com) advertise surplus camera focusing mechanisms (salvaged from Polaroid cameras and the like) that can be adapted to sonically detect approaching cars. What I'd do, though, is use a piezo coax cable from AMP (http://www.ampincorporated.com/sensors/coax.html).

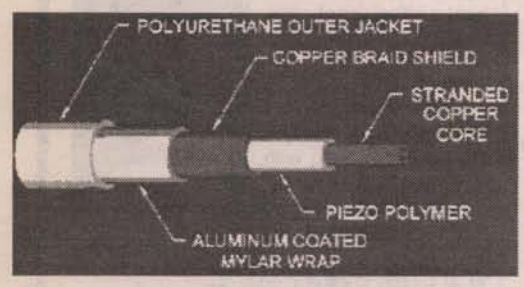
Piezo Coax Cable

Description

- 20 and 24 gage piezo cable
- Continuous Lengths
- Shielded Cable, Polyurethane Jacket

Benefits

- Flexible, robust
- Low Cost
- Self-shielded
- Direct Lead Attach to Circuitry



Applications

- Traffic and Pedestrian Sensors
- Occupancy Sensors
- Perimeter Surveillance
- Fence Security
- Door Edge Sensing

This cable is inserted into the driveway via a small groove (the coax is only 0.03 inches in diameter). When a car runs across the sensor, a voltage is generated; the voltage is proportional to the weight of the vehicle, so you can tell if it's a car or bicycle. Moreover, you can measure the time between front and read axle impact to determine the speed of the car. The coax is low cost, easily installed, and comes in lengths of 500 feet and more. And because it's a low-tech solution, it's extremely reliable.

Quieting The Din

Q. I'm trying to build a listening device that can pick up faint sounds from far away. I have a prototype, but it's pretty noisy even without the microphone connected. I'm using an LF412 JFET op amp and an RC filter with a cut-off frequency of about 12 KHz. Each half of the LF412 has a gain of 1001 (non-inverting configuration) for a total gain of 1002001. The problem is that the noise is also being amplified with a magnitude of about 3Vp-p. Do you have any suggestions as to how I can improve my design? Perhaps using a different op amp?

Benjamin Fok
via Internet

A. *Yes, I have several suggestions.*

1. *Reduce the gain of the first op amp from 1001 to 100. The first stage is always the greatest source of noise. I'd also cut the second stage gain to 500 or less, and add a third stage if you need more amplification.*

2. *Use a low-impedance microphone instead of a high-impedance unit, and place a resistor equal the value of the mike's impedance across the input of the first stage.*

3. *Bypass the Vcc and GND of the op amp with 0.1 uF Hi-Q ceramic disc capacitors – as close to the IC body as possible.*

4. *Instead of running the op amp off a single power source, switch to a split power supply of +15 (Vcc) and -15 volts (Vdd). The higher the operating voltage, the greater the voltage swing on the output and the less noticeable the noise.*

5. *If possible, power the circuit from batteries. Bypass the Vcc and Vdd lines to GND with a 470 uF electrolytic at the point where the voltages enter the circuit board.*

6. *Use precision (1%) metal-film resistors in place of carbon-film resistors.*

7. *Avoid ground loops by returning all ground wires/traces to a single point. If you have the skills and equipment, fabricate a multi-layer printed circuit board with a power (Vcc) plane and a ground plane sandwiched in the middle.*

8. *Twist the microphone wires together. This will insure that any noise is present on both wires, allowing superior noise rejection.*

9. *Avoid sudden temperature changes to the circuit.*

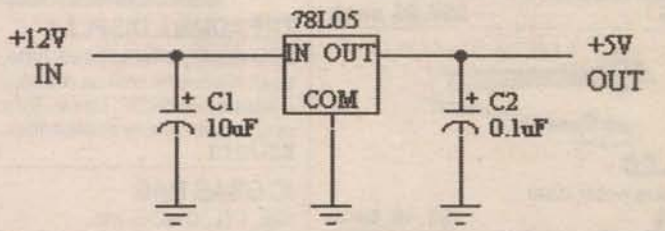
Finally, I assume you're using some kind of parabolic sound collector. If not, consider it or a "shotgun" tube equivalent.

Suitable Capacitor Substitutes

Q. In your Dec. '97 column on building a telephone busy circuit, you show two polarized capacitors with values of 1 uF and .01 uF. Where can I buy these? Can I use a tantalum capacitor?

Chuck Bucci
via Internet

A. *These are common items that you can buy at Radio Shack or from Digi-Key (800-344-4539; http://www.digikey.com). Neither is critical, and a tantalum is certainly acceptable for the 1 uF capacitor. The key to substituting capacitors is to look at the application. When the capacitor is used to filter a power supply, as is the case with C1 in the circuit below, just about any electrolytic or tantalum capacitor will work.*



Simply replace C1 with a value equal to or slightly higher than the one specified. C2, on the other hand, is more critical because it's used to bypass fast-rising voltage spikes – something electrolytics aren't particularly good at. For this you'll want to use a ceramic capacitor, such as a Radio Shack 272-135.

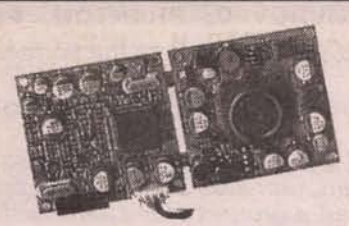
Disabling Built-In Video

Q. The graphics on my AMD 486DX4 (100 MHz) PC are less than stunning (in fact, they're terrible), and I'd like to upgrade it to 3D graphics using one of the newer video cards. The problem is that the video adapter is built into the motherboard and I don't know how to disable it? Do you have any suggestions?

Cybill
via Internet

A. *It depends on your machine. In virtually all PCs with built-in video, you can disable the on-board controller via the CMOS setup menu. To bring up this menu, turn on your computer and press the CMOS key sequence (usually Del or Esc/Enter) when prompted. This is a short time window, so if you miss it you'll have to turn off the machine and try again. Once the setup menu is on the screen, scroll through the menus until you locate the line that says something like "Built-in video:*

(Continued on page 111)



COLOR PINHOLE TV CAMERA

Overall size: 42mm x 42 x two boards. Board may be separated for smaller configuration. Microphone: Installed on camera. Lens: Pinhole, 3.7mm, 90° field of view. Sensitivity: <2 Lux. Electronic Iris: Auto. Horizontal Resolution: 340 Lines. Power Supply: 12VDC (included).

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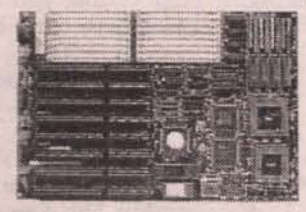

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486-DX50 with 128K cache memory, AMI BIOS, sixteen 30-pin SIMM slots (up to 64MB RAM, eight 16-bit ISA slots. CPU extra.

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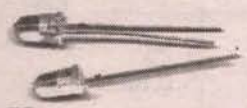
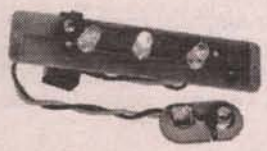


BLUE LED

T1-3/4 blue water clear.

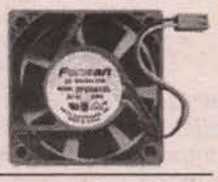
SE5064 **$1.49 each**



FLASHING LED KIT

Three extra-bright LEDs flash in unison on this 9V battery powered board. Use as safety warning for auto or bicycle, party gimmick, sea buoy, etc. Kits may be used in series to form an array.

95K001 **Kit of Parts $3.95**



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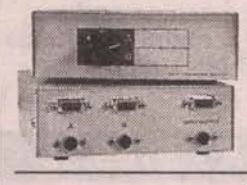
2.375" square by 0.75" thick.

94F004 **$4.95**



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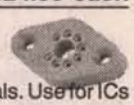

EIGHT-PIN TO-3 SOCKET

Panel-mount with turret terminals. Use for ICs such as LH0063.

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UNIPOLAR STEPPER MOTOR DRIVER IC

UCN5804. Drives a unipolar stepper in one of three operating modes: single phase, two phase or half step. Up to 1.25 Amps per phase. Step and direction input. Drive with a 555 timer, parallel port, etc. Build your own robot, anything that requires precision positioning.

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NIPPON PULSE MOTOR

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COMBO PACK!

One 93I002 IC and 92M010 motor (both shown above) with schematics.

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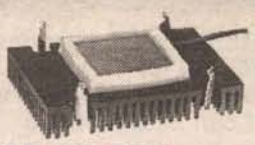

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97M022 **$9.95 each**

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Nominal Specificatons:

Operating power: 1V, 5A. Electrical resistance: 0.2 Ohms. Pull in cycle: 2 sec. Relax cycle: 8 sec. Max. cycle rate: 6 cpm. De-energized length: 100mm. Energized length: 75mm. Diameter: 9mm. Stroke: 20mm. Self-activating temperature: 165°F.

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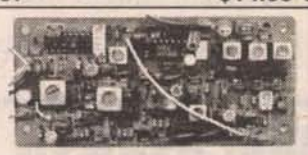

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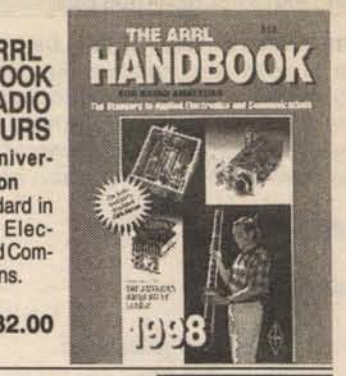

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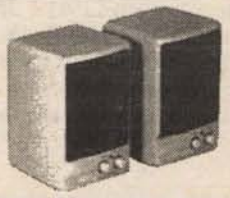

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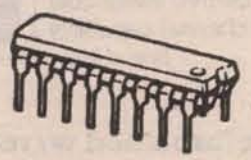

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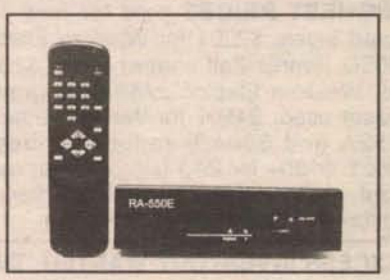

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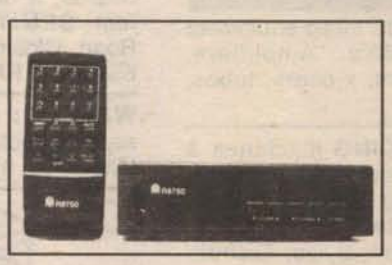

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Willow Grove 19090

Lehman Scientific
2997-F Cape Horn Rd.
Red Lion 17356

Penn Electronics
2310 A Walnut St.
Harrisburg 17103

Surplus Al
RR 1 Box 337
Hunlock Creek 18621

Tower Books
425 South St.
Philadelphia 19147

Tower Records
340 W. Dekalb Pike
King of Prussia 19406

SOUTH CAROLINA

555 Electronics
5646 Farrow Rd.
Columbia 29203

TENNESSEE

Tower Books
204 W. End Ave.
Nashville 37203

TEXAS

BDL News, Inc.
809 Pierce
Houston 77002

Electronic Parts Outlet
3753-B Fondren Rd.
Houston 77063

Tanner Electronics
1301 W. Beltline #105
Carrollton 75006

The Communication Source
2713 Galleria Dr.
Arlington 76011

Tower Records
2403 Guadalupe
Austin 78705

VIRGINIA

Satellite Headquarters
7920 Timberlake Rd.
Lynchburg 24502

Tower Records/Video/Books
6200 Little River Tpk.
Alexandria 22312

4110 W. Ox Rd. #12124
Fairfax 22033

1601 Willow Lawn Dr.
Richmond 23230

8389 E. Leesburg Pike
Vienna 22182

WASHINGTON

A-B-C Communications, Inc.
17541 15th Ave. NE
Seattle 98155

Cody Books Ltd.
1122 Fir Ave.
Blaine 98230

Supertronix
18650 68th Ave. S.
Kent 98032

Tower Books
10635 NE 8th St.
Bellevue 98004

20 Mercer St.
Seattle 98109

WISCONSIN

Amateur Electronic Supply, Inc.
5710 W. Good Hope Rd.
Milwaukee 53223

News & Hobby Center
4758 Packard Ave.
Cudahy 53110

dealer directory dealer directory dealer directory dealer directory dealer directory dealer directory dealer directory

by Ray Marston

SECURITY ELECTRONICS SYSTEMS AND CIRCUITS — Part 1

Ray Marston explains electronic security system basic principles in this opening episode of this new series.

SECURITY SYSTEM BASICS

Any system that provides its owner/user with a reasonable degree of protection against one or more real or imagined dangers, threats, or nuisances (such as physical attack, theft of property, unwanted human or animal intrusion, machine breakdown, or risks from fire, electric shock, or vermin infestation, etc.) can be described as a 'security' system.

An 'electronic' security system is one in which the system's actions are heavily dependent on electronic circuitry. Simple examples of such systems are electronic door bells and mouse traps, key-pad door locks, and domestic burglar alarms.

This opening episode of this new series starts off by explaining electronic security system basic principles and then goes on to describe a wide variety of devices that can be used within modern electronic security systems.

This basic theme is continued in next month's part of the series, but all subsequent episodes will show practical examples of various specific types of low- to medium-complexity electronic security systems and circuits.

ELECTRONIC SECURITY SYSTEM BASICS

All electronic security systems consist of the basic elements shown in Figure 1. Here, one or more 'danger' sensing units are placed at the front of the system and generate some kind of electrical output when danger is sensed. The output of the sensor unit is fed, via a data link, to a decision-making signal processing unit, and this unit's output is fed, via another data link, to a 'danger' response unit such as an alarm or an electromechanical trigger or shutdown device.

Note in Figure 1 that each of the system's three major elements is shown using its own power supply, but that, in practice, two or more elements may share a single power supply.

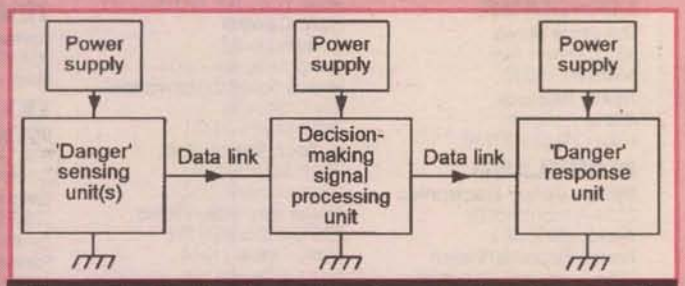

Figure 1. Basic elements of an electronic security system.

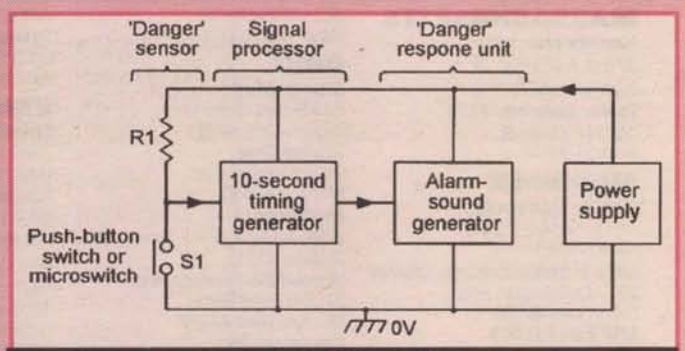

Figure 2. Electronic doorbell or shop-entry system.

Figures 2 to 5 show, in basic form, four different low- to medium-complexity types of security system. The first of these (Figure 2) is a simple electronic door-bell or shop-entry alarm system, in which the 'danger' sensor is a push-button switch in the case of the door-bell system or a door-mounted microswitch (or a pressure mat switch, etc.) in the case of the shop-entry system.

In both cases, the circuit action is such that when switch S1 closes it activates a timing generator that turns on an alarm sound generator for a period of 10 seconds, irrespective of the actual duration of the switch closure, and repeats this action each time that S1 is closed.

Ideally, this type of circuit draws zero quiescent current. Note, in the case of the door-bell circuit, that the 'danger' sensor (S1) is operated voluntarily by the unknown visitor, in a deliberate effort to attract the attention of the householder, but that in the case of the shop-entry circuit, S1 is operated involuntarily by the visitor, and warns the shopkeeper of the presence of a potential customer or thief.

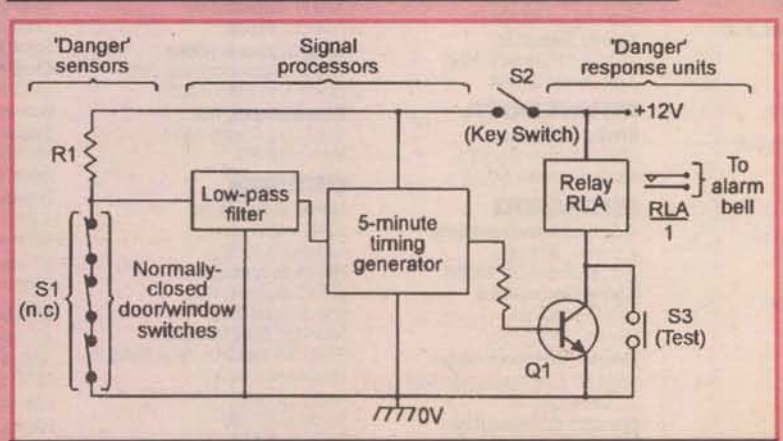

Figure 3. Simple domestic burglar alarm system.

Figure 3 shows a simple domestic burglar alarm circuit. Here, the main alarm system is enabled by closing key-operated switch S2, and the S1 'danger' sensor actually consists of any desired number of series-connected normally-closed switches (usually reed-and-magnet types) that are each wired to a protected door or window, so that the composite S1 switch opens when any protected door or window is opened or a break occurs in S1's wiring.

Under this condition, R1 pulls the input of the transient-suppressing low-pass filter high and, after a brief delay (usually about 200 mS), the filter output triggers the five-minute timer generator, which turns on relay RLA via transistor Q1 and thereby activates an external alarm bell or siren via the relay's RLA/1 contacts.

Once activated, the relay and alarm turn off automatically at the end of the five-minute timing period, but can be turned off or reset at any time by opening key-switch S2. The alarm can be tested at any time, with or without closing S2, via push-button switch S3, which closes RLA directly.

Figure 4 shows, in pictorial form, a modern passive infrared (PIR) movement detector system that can be used to automatically sound an alarm or turn on floodlights when a person enters the PIR detection field

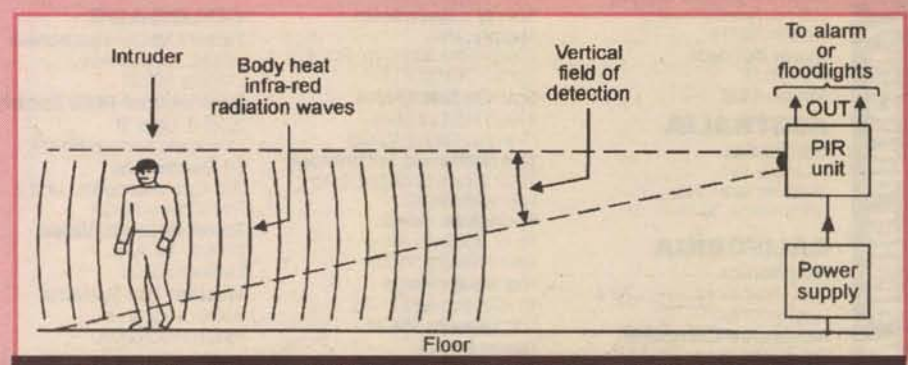

Figure 4. Passive infrared (PIR) movement detector system.

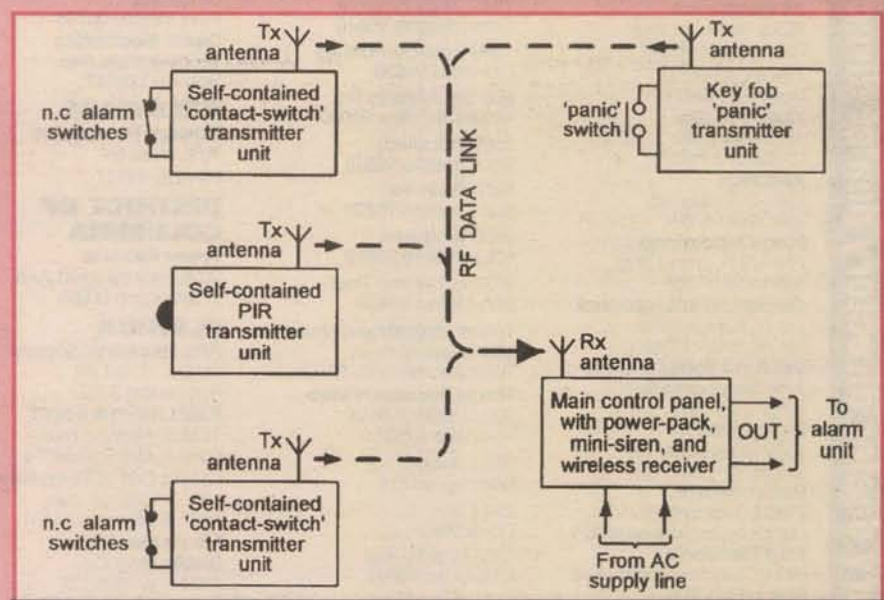

Figure 5. Wireless burglar alarm system.

(the PIR has a typical maximum range of 12 meters and the field has a vertical span of about 15 degrees and a horizontal span of 90 to 180 degrees).

The PIR unit detects the small amounts of infrared radiation generated by human body heat, but gives an 'alarm' output only when the heat source moves significantly within the detection field. Most PIR units have good immunity to false alarms; some types incorporate an output relay that is normally closed (turned on), but opens (turns off) when an intruder is detected or the unit's power supply fails or is removed; units of this latter type typically need a 12V DC supply and consume a quiescent current of about 20 mA. PIR units are widely used to give room or area protection in modern burglar alarm systems.

Figure 5 shows — in simplified form — the basic elements of a modern domestic 'wireless' burglar alarm system, in which the data links between the various major parts of the system take the form of a coded RF (usually 418 MHz or 458 MHz) signal, thus greatly easing installation problems.

The heart of the system is the main control panel, which houses a wireless receiver and decoder and control logic, plus a high-power mini-siren, and has an output that can activate an external high-power siren and light-strobe alarm unit. The system's 'danger' sensing units each house a small RF transmitter and antenna that send out a coded signal under a danger condition; each of the units are designed to give a minimum of six months of normal operation from a small battery.

Most domestic wireless burglar alarm systems can be used to monitor a maximum of four to six zones (individual protected areas) via suitable sensing units. The sensing units come in three basic types: 'contact-switch' types transmit a danger signal when one or more series-connected normally-closed switches are opened, and can be used to protect a zone of any desired size; 'PIR' types transmit a danger signal when a human moves within the visual field of the PIR unit, and can be used to protect a zone of limited size; 'panic' types transmit a danger signal when a key-fob button is pressed, and can be used to protect a person against sudden physical attack or threat whenever they are within communication range of the system's receiver (control panel) unit.

All three types of sensing units also send out monitoring signals that give warnings of failing battery power or deliberate interference, etc., and the wireless burglar alarm system thus offers a high degree of security.

Note that simple electronic security systems such as those shown in Figures 2 and 3 can be easily and cheaply built on a DIY basis, but that it is not cost-effective to build a PIR unit of the Figure 4 type as a DIY project, or cost-effective or legal (because the RF transmitters must be certified by an approved state or national body) to build (rather than buy) a Figure 5 type of wireless burglar alarm system as a pure DIY project.

Commercial PIR units and wireless burglar alarm units can, however, easily be used as special elements that can be incorporated in a wide variety of DIY security systems.

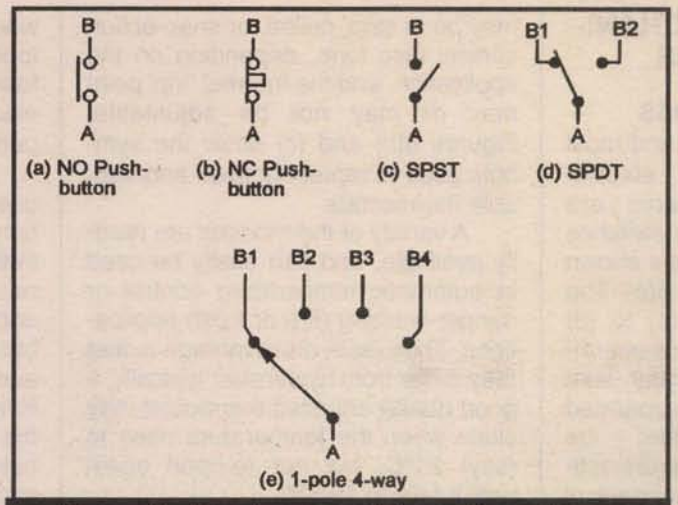

Figure 6. Five basic switch configurations.

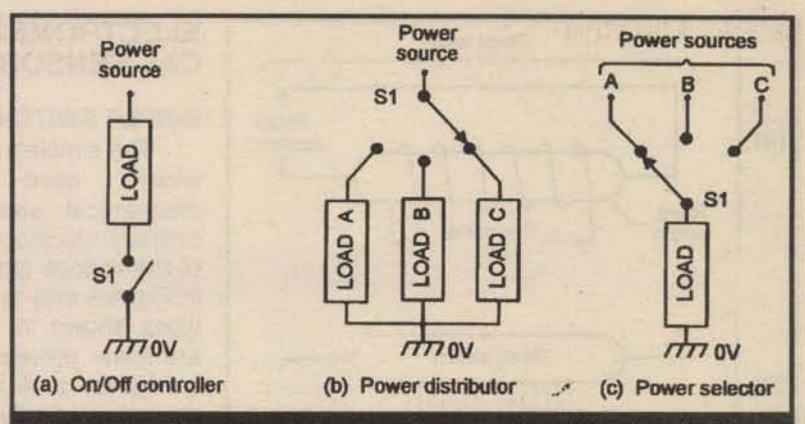

Figure 7. Three basic types of power (or signal) switching circuit.

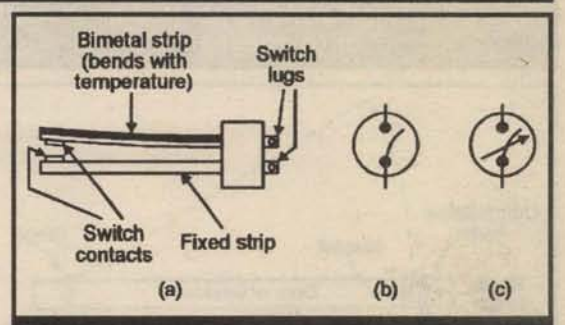

Figure 8. Basic construction of a simple bimetal thermostat (a), and symbols for (b) fixed and (c) variable thermostats.

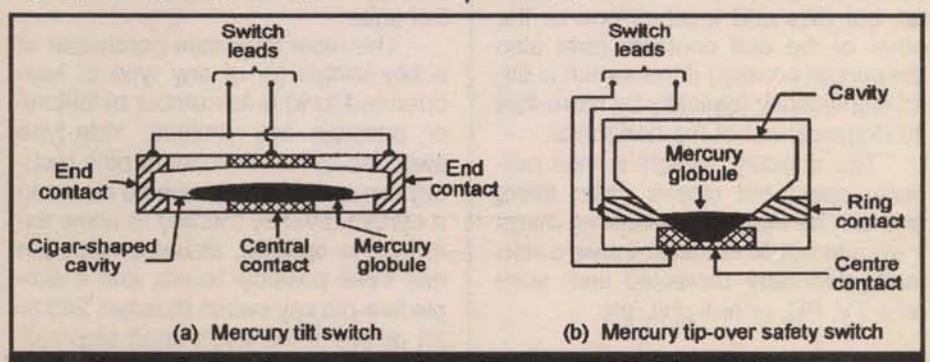

Figure 9. Basic construction of mercury tilt (a) and tip-over (b) switches.

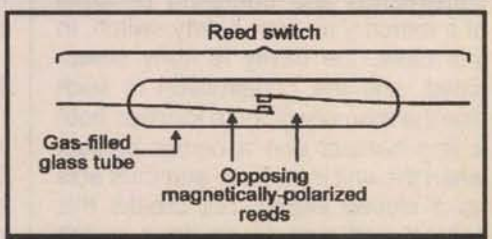

Figure 11. Basic structure of a reed switch.

SECURITY SYSTEM RELIABILITY

The most important parameter of any practical electronic security system is its reliability in performing its designated task. Specifically, all such systems must be easy to use, difficult to disable, and have good immunity against malfunctioning and the generation of false alarms (which very quickly destroy the user's confidence in the system).

The degree and types of reliability required from a security system vary with the level of security that the system is designed to provide. Domestic burglar alarm systems (in which only a few family members have access to the major functional parts of the system) have, for example, relatively low anti-tamper requirements, but anti-burglary systems used in large shops and stores — in which the public has easy access to many protected areas during normal 'opening' hours — have very high levels of anti-tamper requirement.

The overall reliability of any electronic security system is greatly influenced by the nature of its major system elements, i.e., by its danger sensing units and its data links, etc.

Simple electromechanical danger sensors such as reed-switches and pressure pad switches have, for example, far greater intrinsic levels of reliabilty than electronic sensors such as ultrasonic, microwave, and simple light-beam intrusion detectors, but electronic key-pad security switches usually have far greater reliability than the mechanical key switches that they are designed to replace, and so on.

To gain a useful insight into this subject, the reader needs a good understanding of the wide variety of elements that are used in modern electronic security systems, as follows:

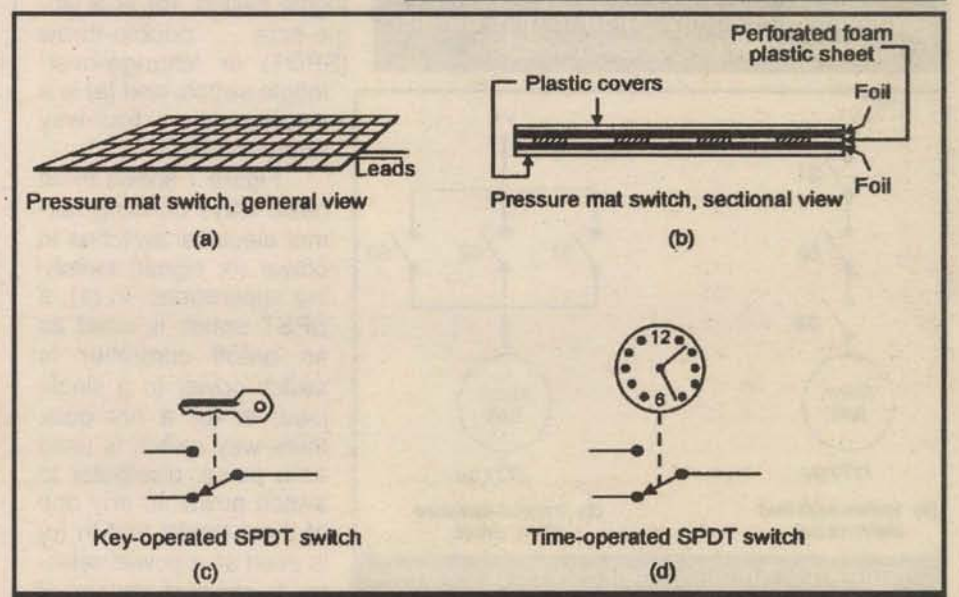

Figure 10. General (a) and sectional (b) views of a pressure mat switch, and symbolic representations of (c) key-operated and (d) time-operated SPDT switches.

SECURITY SYSTEM ELEMENTS

All electronic security systems consist — as shown in Figure 1 — of one or more 'danger' sensing units that generate some kind of electrical output when danger is sensed, and which feed that output — via a data link and a decision-making signal processing unit — to a 'danger' response unit such as an alarm or an electromechanical trigger or shutdown device.

Apart from the actual signal processing unit, the three other major

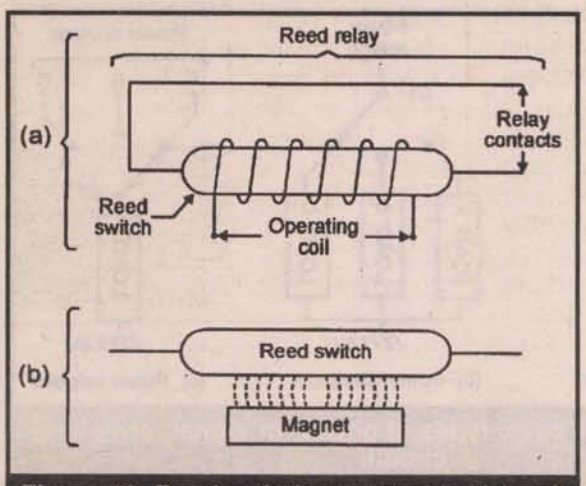

Figure 12. Reed switch operated by (a) coil or (b) magnet.

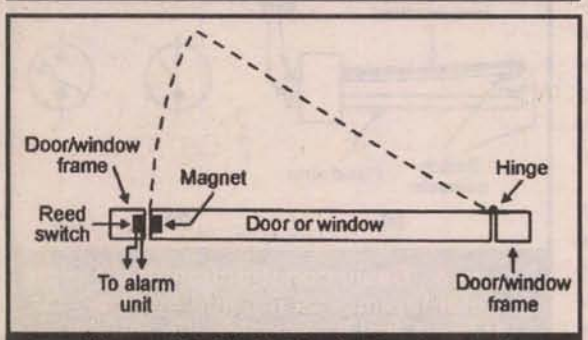

Figure 13. Method of using a reed switch/magnet combination to give burglar protection to a door or window.

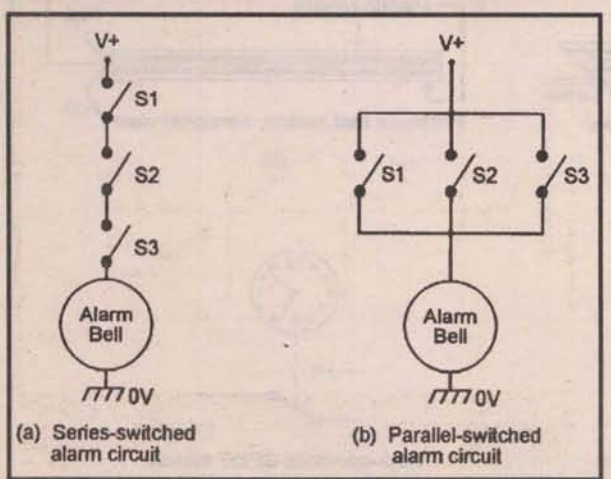

Figure 14. An alarm bell can be activated by several switches wired (a) in series or (b) in parallel.

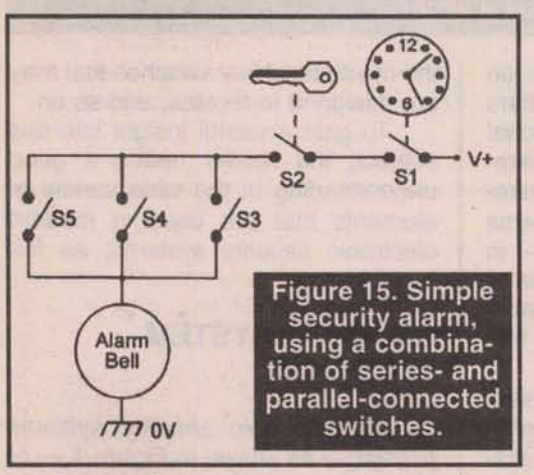

Figure 15. Simple security alarm, using a combination of series- and parallel-connected switches.

elements of any electronic security system are thus the sensing unit, the data link, and the response unit, and each of these elements may take an electro-mechanical, electrical, or an electronic form.

Each of these three basic elements are available in a variety of guises, and the most important of these is described in the remaining sections of this chapter.

ELECTROMECHANICAL SENSORS

SIMPLE SWITCHES

The simplest and most widely used electro-mechanical sensors are ordinary electrical switches of the various types shown in Figures 6(a) to 6(e). The types shown in (a) to (d) are linear pressure-operated types, and may take normal manually-operated forms, or may be microswitches that are activated by the mechanical movement of a door, window, or machine part, etc. The (e) type is a rotary multi-step, pressure-operated switch that is (normally) activated manually.

The sensor shown in (a) is a normally-open (NO or n.o.) push-button switch; (b) is a normally-closed (NC or n.c.) push-button switch;, (c) is a single-throw single-pole (SPST) toggle switch, (d) is a single-pole double-throw (SPDT) or 'change-over' toggle switch; and (e) is a single-pole four-way rotary switch.

Figure 7 shows three basic ways of using normal electrical switches in power (or signal) switching applications. In (a), a SPST switch is used as an on/off controller to switch power to a single load; in (b) a one-pole, three-way switch is used as a power distributor to switch power to any one of three loads; and in (c) is used as a power selector, to connect any one of three power sources to a single load.

Switched-output electro-mechanical sensors are available in a variety of basic types, including temperature-sensitive thermostats, orientation-sensitive 'tilt' and 'tip-over' switches, pressure-sensitive 'mat' switches, key-operated security switches, and time-sensitive 'timer' switches, all of which are shown in basic form in Figures 8 to 10.

THERMOSTATS

Thermostats are temperature-activated on/off switches that usually work on the 'bimetal' principle illustrated in Figure 8(a), in which the bimetal strip consists of two bonded layers of conductive metal with different coefficients of thermal expansion, thus causing the strip to bend in proportion to temperature and to make (or break) physical and electrical contact with a fixed switch contact at a specific temperature.

In practice, the bimetal element may be in strip, coiled, or snap-action conical disc form, depending on the application, and the thermal 'trip' point may or may not be adjustable. Figures 8(b) and (c) show the symbols used to represent fixed and variable thermostats.

A variety of thermostats are readily available, and can easily be used in automatic temperature control or danger-warning (fire or frost) applications. Their main disadvantage is that they suffer from hysteresis; typically, a good quality adjusted thermostat may close when the temperature rises to (say) 21°C, but not re-open again until it falls to 19.5°C.

TILT SWITCES

Figure 9(a) illustrates the basic construction and operating principle of a mercury tilt switch, which (in this example) consists of a cigar-shaped cavity that is formed within a block made of two electrically-connected metal end contacts and a central metal contact, which are separated by insulating sections.

The cavity holds a mercury globule, which rests on the central contact, but is insulated from the end contacts when the switch is horizontal, but rolls and touches one or the other of the end contacts (and also the central contact) if the switch is tilted significantly (typically by more that 10 degrees) out of the horizontal.

The mercury 'switch' is thus normally open, but closes when tilted, and can be used to activate an alarm if an attempt is made to move a normally-stationary protected item such as a TV, PC, or hi-fi unit, etc.

TIP-OVER SWITCHES

Figure 9(b) illustrates the basic construction and operating principle of a mercury tip-over safety switch. In this case, the cavity is fairly steep-sided, and the construction is such that the mercury globule touches both a ring contact and a center contact when the unit is vertical, and thus acts as a closed switch, but breaks this contact and acts as an open switch when the unit is tilted heavily (typically by more than 40 degrees) out of the vertical position.

One common application of this type of switch is in free-standing electric heaters, where the switch is built into the unit and wired in series with its power lead, so that the appliance automatically turns off if it is accidentally knocked over.

PRESSURE MAT SWITCHES

Figures 10(a) and 10(b) illustrate the general appearance and basic construction of a pressure mat switch, which is designed to be hidden under a mat or carpet, and acts as a normally-open switch that closes if a person steps heavily on any part of the switch.

The device consists of two sheets of metal foil that are normally held apart by a perforated sheet of foam plastic; this sandwich is encased in a hermetically sealed plastic envelope; when a person treads on the envelope their weight compresses the foam plastic, and the metal foils make electrical contact via the foam sheet's perforations.

Pressure mat switches are widely used in domestic and commercial burglar alarm systems; most such switches have four output wires; the two 'switch' wires have partly-bared ends. The other two wires are not bared, are internally shorted together, and serve an n.c. anti-tamper function in which an alarm system activates if the sensor wiring is cut (this technique is described in the DATA LINKS section of next month's eposode of this series), and can be ignored in most domestic applications.

KEY SWITCHES

Figure 10(c) shows a symbolic representation of a simple key-operated SPST electric switch, in which the switch arm is moved by turning a Yale-type key in a matching tumbler mechanism. Switches of this basic type are available in many different switch and key-type styles, and are widely used in security applications in buildings and vehicles, and on items such as PCs and burglar alarm control units.

The most important parameter of a key switch (or of any type of key-operated lock) is its number of 'differs' or possible key profiles; Yale-type switches have a number of pins (usually five) which must each be raised to a certain level by the key to allow the switch to operate. Usually, each pin has three possible levels, and a simple five-pin key switch thus has 243 (= 3^5) differs; if the key's shaft also carries two long grooves that must match the lock's face plate and offer (say) a further nine differs, the total number of differs is raised to 2187.

TIME SWITCHES

Figure 10(d) shows a symbolic representation of a simple analog time-operated SPST electric switch, in which the switch arm is moved by a mechanical (clockwork or slow-release), electrical (current-heated thermostat), or electromechanical (synchronous motor plus gearbox) timing mechanism.

Switches of this basic type are available in many different switch styles, with many different timing ranges, and are widely used in light-switching and solenoid-operating security applications.

REED SWITCHES

One of the most useful types of switched-output electro-mechanical sensor devices is the 'reed' switch, which activates in the presence of a suitable magnetic field and is particularly useful in proximity-detector applications.

Figure 11 shows the basic structure of a reed switch, which consists of a springy pair of opposite-polarity magnetic reeds with plated low-resistant contacts, sealed into a glass tube filled with protective gasses. The

opposing magnetic fields of the reeds normally hold their contacts apart, so they act as an open switch, but these fields can by nulled or reversed by placing the reeds within an externally-generated magnetic field (see Figure 12), so that the reed then acts as a closed switch.

A reed switch can be activated by placing its reeds within an externally-generated magnetic field, which can be derived from either an electric coil that surrounds the glass tube, as in the 'reed relay' diagram of Figure 12(a), or by a permanent magnet placed within a few millimeters of the tube, as shown in Figure 12(b).

Reed relays are used in the same way as normal relays, but typically have a drive-current sensitivity 10 times better than a standard relay. Reed-and-magnet combinations are very useful in proximity-detector applications in security and safety systems, etc., as illustrated in Figure 13.

Figure 13 shows a method of using a reed and magnet to give burglar protection to a door or window. Here, the reed switch is embedded in a door or window frame, and the activating magnet is embedded adjacent to it in the actual door or window so that the reed switch changes state whenever the door/window is opened or closed. The reed switch can thus be used to activate an alarm circuit whenever a protected door/window is opened. In practice, the reed and magnet may take the basic forms shown in Figure 12(b), or may be encapsulated in special housings that can easily be screwed to — or embedded in — the frame/body of the door/window.

BASIC ALARM SWITCHING CIRCUITS

Several switched-output sensor devices can be used to activate an alarm bell or other device by connecting them in one or other of the basic modes shown in Figure 14. In (a), the switches are wired in series and the alarm thus sounds only when all three switches are closed at the same moment. In (b), the switches are wired in parallel and the alarm sounds when any switch is closed. In most practical alarm systems, a mixture of series and parallel switching is used, as shown in the example of Figure 15.

Here, the alarm system is enabled (made alert) by closing series-connected time switch S1 and key switch S2; once enabled, the alarm bell can be activated by closing any of the parallel-connected S3 to S5 switches.

In burglar alarm systems, important intrusion-sensing switches should be n.c. types that are wired in series and used in the basic manner already shown in Figure 3, so that the alarm activates if any switch opens or if its wires are cut; R1 should have a high value (typically several megohms) to give low quiescent current consumption.

ELECTRICAL SENSOR DEVICES

THERMISTORS

A thermistor is a passive resistor device with a resistance value that is highly sensitive to the device's temperature. Practical thermistors are available in rod, disc, and bead forms, and with either positive or negative temperature coefficients (known as PTC and NTC types, respectively).

Unlike electromechanical thermostats, they do not suffer from hysteresis problems, and are thus suitable for use in a variety of precision temperature sensing and switching applications.

Figure 16 shows two alternative symbols that can be used to represent a thermistor. In most practical applications, thermistors are used in conjunction with electronic circuitry that gives a switch-type output when the thermistor temperature goes above (or below) a pre-set limit. Thermistors have typical operating temperature ranges of -40°C to +125°C.

THERMOCOUPLES

When a junction is formed between two dissimilar metals, a thermo-electric (temperature-dependent) voltage is generated across the junction.

Thermocouples are devices in which the two types of metal are chosen to exploit this effect for temperature-measurement purposes; a device using a copper and copper-nickel junction, for example, has a useful 'measurement' range from -100°C to +250°C and has a typical sensitivity of 42 µV per °C over the positive part of that range. Some devices using other types of metal have useful measurement ranges that extend above +1100°C.

Figure 17(a) shows the symbol used to denote a normal thermocouple. In some special types of thermocouple devices, the junction can be heated via a DC or RF current passed through a pair of input terminals, and the unit's output can then be used to indicate the magnitude of the input current or power; units of this type use the symbol shown in Figure 17(b).

LIGHT-DEPENDENT RESISTORS (LDRs)

An LDR (also known as a cadmium sulphide (CdS) photocell) is a passive device with a resistance that varies with visible-light intensity. Figure 18 shows the device's circuit symbol and basic construction, which consists of a pair of metal film contacts separated by a snake-like track of light-sensitive cadmium sulphide film; the structure is housed in a clear plastic or resin case.

LDRs have many practical applications in security and auto-control systems. Figure 19 shows the typical photoresistive graph that applies to an LDR with a face diameter of about 10 mm; the resistance may be several megohms under dark conditions, falling to about 900R at a light intensity of 100 Lux (typical of a well-lit room) or about 30R at 8000 Lux (typical of bright sunlight).

MICROPHONES

Microphones are acoustic-to-electrical transducers and have a number of uses in eavesdropping and other security applications. The three best known types of electrical microphones are the moving-coil ('dynamic'), ribbon, and piezo-electric ('crystal') types.

In most security electronics applications, microphones are required to be small but sensitive types that generate medium-fidelity outputs; electronic 'electret' microphones are widely used in such applications.

Until next month ... **NV**

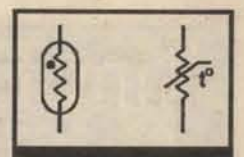

Figure 16. Symbols commonly used to represent a thermistor.

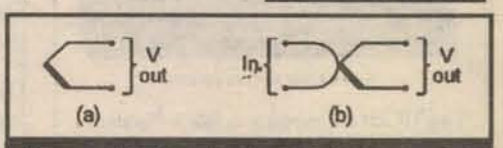

Figure 17. Symbols of (a) a conventional and (b) an electrically-heated thermocouple device.

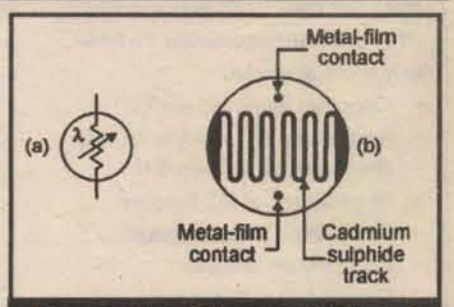

Figure 18. LDR symbol (a) and basic structure (b).

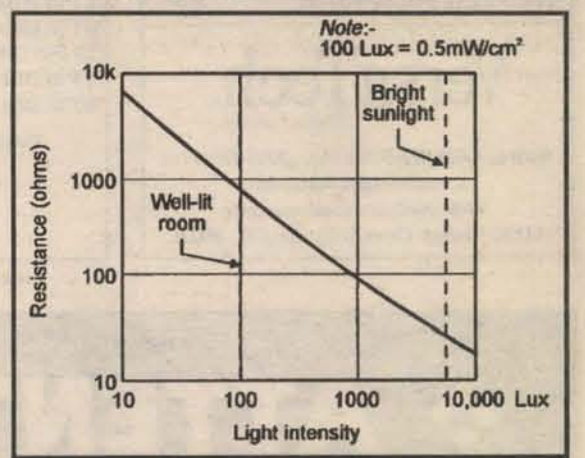

Figure 19. Typical characteristics curve of an LDR with a 10 mm face diameter.

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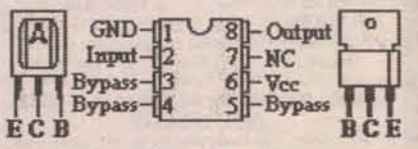

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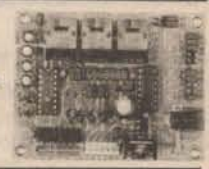

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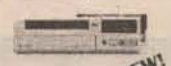

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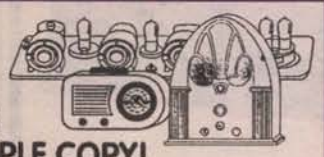

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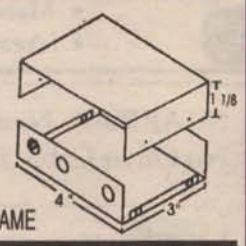

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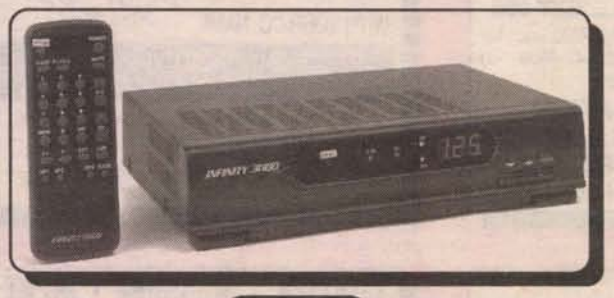

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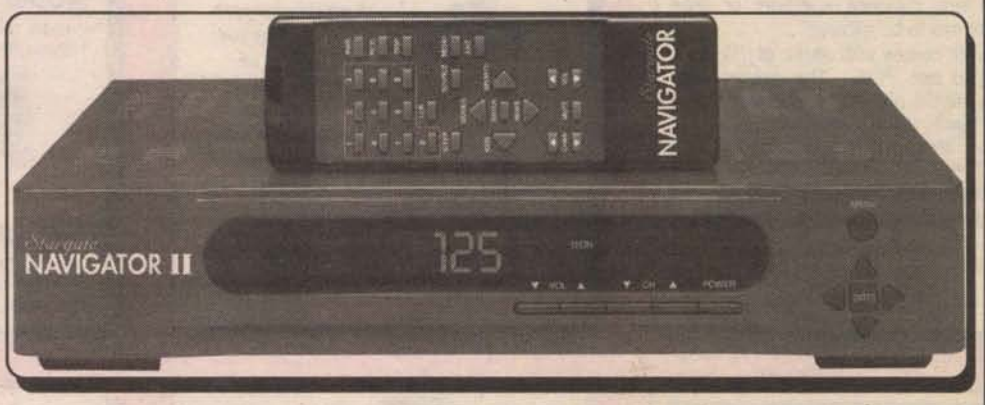

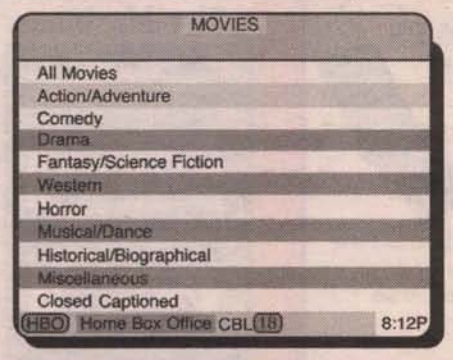

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Events CALENDAR

Continued from page 29

sdowdy@qni.com
TN - KNOXVILLE - Hamfest. Kerbela Shrine Temple, 8am-4pm. Paul Baird K3PB, 423-986-9562

MARCH 14-15

TX - MIDLAND - Hamfest & W. TX State Conv. Midland County Exhibit Bldg., E. Bus. 20. Sat: all day, Sun: 8am-3pm. Beverley Harwood KC5BNT, 915-686-1841. E-Mail: shamrock@apex2000.net

MARCH 15

IL - STERLING - Hamfest. High School Field House, 1608 4th Ave. Lloyd Sherman KB9APW, 815-336-2434. E-Mail: lsherman@essexl.com
IN - NOBLESVILLE - AGI Computer Fair. Hamilton Co. Fairgrounds. 10am-4pm. 317-299-8827. E-Mail: agi@trader.com Web: http://www.surf-ici.com/agi
OH - MAUMEE - Hamfest. Lucas Co. Recreation Center, 2901 Key St. 8am-3pm. Paul Hanslik N8XDB, 419-243-3836
PA - MONROEVILLE - Hamfest & Computer Show. Palace Inn. 8:30am-3pm. 412-754-0562
PA - YORK - Hamfest and Computer Show. York County Vo-Tech School. 8am-3pm. Ted Rodes KE3SO, 717-259-8063. http://members.aol.com/yorkfest
WV - CHARLESTON - Hamfest & Computer Show. Jimmie Hewlett WD8MKS, 304-768-9788
WI - JEFFERSON - ARC Hamfest. Jefferson County Fairgrounds Activity Ctr. Hwy 18 W. 8am-2pm. 414-563-6502 evenings

MARCH 20-21-22

FL - FT. WALTON BEACH - Playground ARC Hamfest. Clyde Gowdy KE4FLC, 850-314-3337. E-Mail: parcfest@aol.com
WI - WEST ALLIS - Super Computer Sale. WI State Fairgrounds. 8100 W. Greenfield Ave. Blue Star Productions 612-788-1901. Web: http://www.supercomputersale.com

MARCH 21

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
FL - STUART - Martin County ARA Hamfest. David Millard KE4AMW, 561-288-7100
GA - MARIETTA - Kennehoochee ARC Hamfest. Jim Cummings KT4MM, 770-517-0073
NJ - WEST ORANGE - Hamfest. West Orange High School, 600 Pleasant Valley Way. 8:30am-1pm. Jim Howe N2TDI, 973-402-6066

MARCH 22

IL - GRAYSLAKE - LAMARSFEST 98. Lake Co. Fairgrounds. 8am-2pm. Dave Gudewicz KB9KDA, 847-937-8227
NC - KINSTON - Down East Hamfest. Doug Burt W4OFO. 919-524-5724
NY - YONKERS - Westchester Emergency Communications Assn. Hamfest. 8am-2pm. Yonkers Raceway. Thomas Raffaelli WB2NHC, 914-741-6606. Web: WWW.WEC.ORG
OH - MADISON - Lake County ARA Hamfest. Roxanne 440-256-0320

MARCH 28

IN - COLUMBUS - Hamfest. Bartholomew County 4H Fairgrounds, Community Bldg. 8am-2pm. Marion Winterberg WD9HTN, 812-342-4670. winterbe@hsonline.net
IN - INDIANAPOLIS - AGI Computer Fair. Indianapolis Events Center. 3655 E. Raymond St. 10am-4pm. 317-299-8827. E-Mail: agi@trader.com Web: http://www.surf-ici.com/agi
KY - ELIZABETHTOWN - Lincoln Trail ARC Hamfest. Harold Bennett AF4AC. 502-351-9599. E-Mail: hbennett@bbtel.com
OR - EUGENE - Hamfest. John Brambora KB7SXS. 541-747-2898

MARCH 28-29

MD - TIMONIUM - Greater Baltimore Hamboree & Computerfest. Timonium Fairgrounds. William Dobson N3WD. 410-HAM-FEST. E-Mail: gbhc@concentric.net Web: http://www.concentric.net/~gbhc

MARCH 29

CA - SANTA ANA - Swapmeet. ACP parking lot. Mary Russo 714-558-8813
CT - SOUTHINGTON - Flea Market. Southington High School. 9am-1pm. Chet KA1ILH, 860-628-9346
IL - GLEN ELLYN - Computer Show & Sale. College of DuPage. Main Arena of Phys Ed Bldg. Corner of Park Blvd. & College Rd. 9:30am-3pm. Computer Central Shows 847-940-7547
IL - TAYLORVILLE - Christian County Hamfest. David E. Nation, Sr. KA9JHW, 214-824-3707. E-Mail: ka9jhw@mindless.com
MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988
OH - CIRCLEVILLE - Hamfest & Computer Show. Pickaway Co. Fairgrounds. Roy Ulko KG8EK, 614-477-8310. E-Mail: royulk@scioto.net

APRIL 1998

APRIL 3-4

GA - ATLANTA - Southeastern VHF Conference. Sandy Donahue W4RU, 404-875-9450. E-Mail: w4ru@arrl.org

APRIL 3-4-5

MI - MT. CLEMENS - Computer & Technology Show. Gibraltar Trade Center, 237 N. River Rd. 810-465-6440

APRIL 4

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
CT - WATERFORD - Ham Radio Auction. Waterford Senior Center on Rte. 85. Tony Griggs AA1JN, 860-859-0162. Web: www.ims.uconn.edu/~rason
NC - MORGANTON - Catawba Valley Hamfest and Computer Fair. Burke Co. Fairgrounds Hwy. 181N. Thomas Taylor KC4QPR. 704-433-6205. E-Mail: kc4qpr@vistatech.net
NH - TWIN MOUNTAIN - Hamfest & Computer Fair. Twin Mountain Town Hall. 8am-3pm. Richard Force WB1ASL, 603-788-4428 bhabooks@together.net
PA - FREDERICKSBURG - Appalachian AR Group Hamfest. Paul Felty WB3HEC. 717-566-2606
WA - VANCOUVER - Clark Co. Hamfest. Luther Brisky KC7KVL. 360-896-8909

APRIL 5

CA - LIVERMORE - Swapmeet. Las Positas College. Noel Anklam 510-447-3857
IA - DELOIT - Denison Repeater Assn. Hamfest. John Amdor KD6MXL. 712-748-8162. E-Mail: johnmxl@netins.net Web: http://www.netins.net/showcase/johnmxl/deloit98. html
NC - RALEIGH - North Carolina State Convention. Wilbur Goss WD4RDT. 919-266-9335
NJ - TRENTON - Delaware Valley Radio Assn. Hamfest. Darryl Foyuth N2JVP, 609-882-2240
WI - MIDDLETON - Madison Area Repeater Assn. Swapfest. John Q. Hammons Trade Center. Jeremy Charles N9VHT. 608-245-8890 http://www.cs.wisc.edu/~jeremyc/mara/swapfest

APRIL 10-11

MS - TUPELO - Tupelo, Booneville and Union Co. ARCs Hamfest. Jack Ellis KI5QV. 601-842-7255

APRIL 11

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves
OK - LAWTON - Lawton Ft. Sill ARC Hamfest. Bob Morford KA5YED, 405-355-6120, 405-353-8074
OR - PENDLETON - Hamfest & Computer Fair. Conv. Center. 8am-4pm. Denton WB7TDG, 541-276-8319. E-Mail: denton@oregontrail.net

APRIL 17-18-19

MI - TAYLOR - Computer & Technology Show. Gibraltar Trade Center, 15525 Racho Rd. 313-287-2000

APRIL 18

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
MO - JOPLIN - ARC Hamfest. Andy Gabbert KA0TUD. 417-673-8371. E-Mail: agabbertka0tud@hotmail.com

APRIL 18-19

AL - BIRMINGHAM - Southeastern Div. Conv. Bill Levey WA4FAT, 205-97-0622. E-Mail: barc@bro.net Web: http://bro.net/barc
CT - HARTFORD - Trinity College Fire Fighting Home Robot Contest. 12pm-5pm. www.trincoll.edu/~robot JMENDEL141@AOL.COM
IL - ELGIN - CoCofest. Holiday Inn, Holidome Indoor Recreation Ctr. Sat: 10am-5pm, Sun: 10am-3:30pm. Tony Podraza 847-428-3576. TONYPODRAZA@JUNO.COM

APRIL 19

MA - CAMBRIDGE - Flea Market. Kendall Square area. MIT. Nick Altemberndt KA1MQX, 617-253-3776
MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988
MN - SHAKOPEE - Southwest Metro AR Hamfest. Helen WB0HOX, 612-361-6782

APRIL 24-25

AR - LITTLE ROCK - Hamfest. Jim Blackmon KB5IFV. 501-246-6736. E-Mail: 1rhamfest@usa.net Web: http://www.aristotle.net/~n5xay/lrh98.html

APRIL 25

IA - DES MOINES - RAA Hamfest. Ron Hobbs N0XWI. 515-255-4020

Continued on page 97

AMATEUR ROBOTICS

by Karl Lunt

There's been a whole lot of cutting and drilling going on, and the base for my fire-fighting robot is taking shape. I started with a round piece of 1/4" thick black Sintra plastic, 11" in diameter. I often use this shape as a starting point, and have always been disappointed at the results I get when I try to cut it myself. Given my limited tool set and mechanical skills, it seemed simpler to pay a professional to do the cutting for me.

I called TAP Plastics, a local plastics house, and ordered a dozen pieces precut to the proper size; I consider the $5.00 each for such nice-looking bases to be a good deal. If you do the same, be sure to ask for a small hole, say about 1/8" in diameter, in the exact center of each base. This will serve as an alignment point for later measurements.

Base mechanics

I mapped out the general outline you see here, cutting a pair of 2" by 1" rectangles on the "left" and "right" sides of the base, to allow room for the 2-3/4" diameter wheels I'll be using. I'm using this size of wheel as a first-order approximation; I may end up with a slightly smaller diameter to give me a little more weight-carrying capacity in the final design. For now, I'm using a pair of Dave Brown Lite-Flite wheels for testing purposes. You can pick these wheels up at nearly any large hobby store, and you can also order them through big catalog outfits such as Tower Hobbies.

I can already see, however, that the foam construction of these wheels isn't going to give me the performance I want. When the robot sits at rest, its weight compresses the foam on the part of the wheel touching the table or floor. Eventually, this creates a flat spot on the wheel's rim, resulting in a lurching motion as the robot rolls around.

While I was in a drilling mood, I measured and drilled holes in the base to hold the two printed circuit boards (PCBs) with the stepper driver electronics. As mentioned in previous columns, I'm using Bill Bailey's chopper driver board to run the two Vexta stepper motors I've selected. These motors take 0.8 amps per winding at 6 VDC, but Bill's board lets me run the motors with a 12 VDC gel-cell battery without resorting to those hurking dropping resistors common to the simpler driver designs.

I also drilled holes to align with the motor mounting brackets that Dan Mauch, another of the Seattle Robotics Society's stalwarts, had designed for me earlier. These brackets, made of 3/16" angled aluminum stock, sport a hole pattern on one face that matches the NEMA-17 layout of the stepper motor form factor. This means I can bolt any NEMA-17 stepper motor to the brackets on my robot, easing the chore of changing motors.

Then I drilled a set of three 1/4" holes near the right wheel, to hold three small toggle switches. The rightmost switch controls MCU power, the middle switch controls power to the motor drivers, and the leftmost switch is a utility control whose function will be determined later. Refer to the accompanying schematic of the power wiring diagram for details.

Please note the grounding point called out in the power wiring diagram. The stepper driver boards might well create some nasty noise spikes as they step the motors, and you need to take precautions so these spikes don't find their way through the grounding system to the MCU board or other electronics.

One way to help ensure this is to use a single common grounding point electrically near the battery. In my case, I ran a short wire from the negative terminal of the battery to a solder-lug, mounted on a 4-40 aluminum standoff near one of the motor driver boards.

All subsystem ground leads connect to this solder-lug directly. DO NOT run a ground lead from your motor driver board to the ground lead of another electronics board, and from there to the grounding point! Use separate runs of wire in each case.

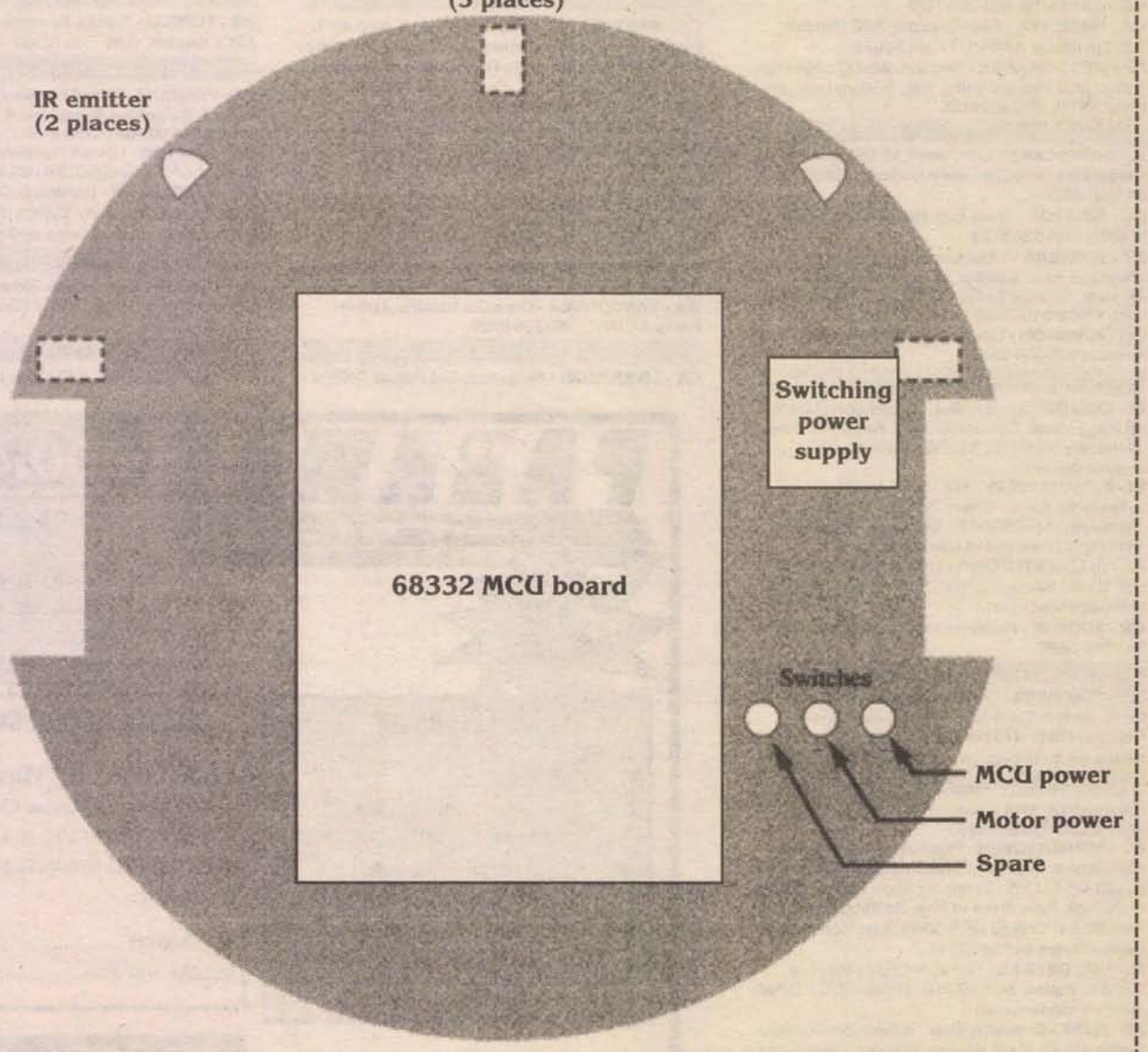
Still in a drilling mood, I next made two pairs of 1/8" holes near the front and back ends of the base, to serve as mounting holes for two skids.

I gave up long ago on casters for my robots, turning instead to large, plastic furniture knobs. The knobs are cheaper, easier to mount, allow for straighter forward motion and more accurate turns, and they come in lots of different colors. Expect to pay about a buck each at any of the large hardware stores.

The knobs all come with a long wood screw to use for mounting to the front of a drawer, but the extra length comes in handy when you need to reach from the lower edge of the base to the floor. In my case, I had to cover a total distance of 1-1/2", far longer than the supplied wood screw. So I resorted to a short length of brass tubing, a 1" piece of blank copperclad stock, and two plastic spacers to fashion a simple adapter. Refer to the accompanying sketch of the mounting adapter for a skid.

Not done yet; I placed the New Micros NMIT-0332 PCB on the top of the base, marked the hole pattern, then drilled six 1/8" holes as needed

General layout of robot base



for mounting spacers. Finally, I put the drill away and checked out the result. Except for a bunch of screw heads and the switch handles, the top surface of my black robot base holds only the computer board. The motor mounts, driver electronics, gel-cell battery, and other circuitry all fit on the underside. I like this arrangement, as it leaves a clean experimental surface on top while providing a low center of gravity.

While developing code earlier on, I powered the 68332 board with an old multi-voltage wall-wart power supply. Since the final robot design uses a 12 VDC gel-cell battery, I need to include some type of power supply to get 5 VDC for the electronics. I eventually chose to use a National Semiconductor LM2595 switching power supply that I had laying around, but not before first checking out an alternative.

The proliferation of very small portable computers has spurred a lot of research on tiny, efficient switching power supplies. As PC models change and new designs appear, the older PC components begin to appear on the surplus market, offering big savings to the experimenter.

I recently picked up a small switcher from MECI (1-800-344-4465), a mail-order surplus outlet. This power supply consists of an assembled and tested PCB measuring less than five inches by two inches, yet it can supply 43 watts of power from any source of DC between 7.2 and 18.5 VDC. It provides up to 2.5 A of current at 5 VDC, more than enough for my robot's needs. It also supplies +12 VDC at up to 800 mA and a small amount of current at -12 VDC and -26 VDC. Best of all, the power supply module costs only $12.95 each.

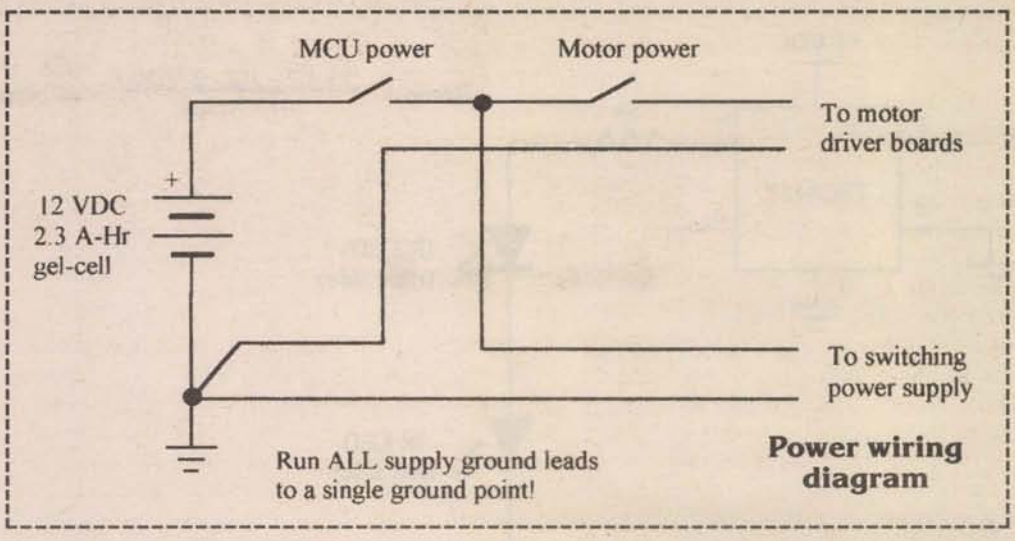
MECI included a single sheet of technical info on the power supply, and the specs should make this supply very appealing to anyone wanting to build a NiCd- or NiMH-powered 'bot. The board can provide a charging current for recharging the batteries in place, though exact details are sketchy and you'll need to do some digging to get this part of the circuit right.

Basically, the board (Astec model AA90801) can accept input voltage from a wall adapter, monitor the signal from a (user-supplied) LM34 temperature probe placed near the batteries, and supply three different current levels of charge. The board also supplies several logical outputs that a computer can use to sense battery condition. This switcher is so small and so versatile that it cries out for inclusion in a robot. Check out MECI part number 500-0080 in their current catalog.

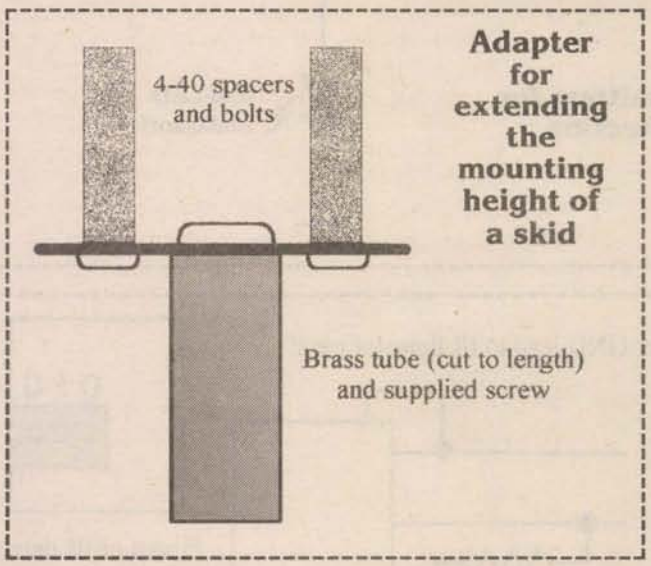
As good as this supply looks, however, I opted for reusing one of the National Semi switchers that I picked up when National was giving away these little one-amp beauties. The PCB has only five parts on it and measures less than 1" on a side, perfect for the limited base space available.

For details on building your own Simple Switcher, check the National Semiconductor web site (www.natsemi.com) and download the data sheets and application notes on the LM259x family of switching ICs. At one time, you could even order sample parts from the web site.

I picked out a location on the robot base to hold the switcher's PCB, near the right wheel on the top surface of the base, then cut a piece of double-sided foam tape to size and stuck the PCB in place. Since I had the foam tape out, I also cut a couple of strips to size and used them to stick the 2.3 AHr gel-cell battery to the underside of the robot base. The battery, purchased from a local surplus store, measures only 7" by 2.5", and its 1.5" height means it nestles just fine amongst the electronics bolted to the underside of the base. I'm not worried about the foam tape not holding the battery firmly since I've had to resort to screwdrivers to pry other gel-cells loose from this tape in the past.



Power wiring diagram



Adapter for extending the mounting height of a skid

Basic electronics

Now I have most of the major mechanical effort on the base out of the way, and I can concentrate on some of the electronics. The 40 KHz subsystem, used for object detection, is usually a simple addition, so I chose that as my starting point. Unfortunately, it didn't go together nearly as well on the 68332 board as it does on my 68hc11 computers. More on that in a bit ...

As long-time readers of this column well know, the TV remote control industry has given robot builders a major toolset for object detection. The little 40 KHz IR detector modules, available from nearly all large mail-order surplus outfits, reduce the circuitry needed to detect an IR signal to a single three-wire component. You can buy these detectors — which measure less than a cubic inch — for about $3.00 each from outfits such as Electronic Goldmine.

Using one of these modules for object detection requires minimal extra circuitry. You must drive an IR LED with a 40 KHz, 50% duty-cycle squarewave, then position the LED and detector so any object within the desired direction and distance reflects the 40 KHz light back onto the detector module. Normally, the IR detector's output floats, so you will have to wire it through a pull-up resistor to +5 VDC. Thus, your robot's computer will see a logic 1 on the detector's output if the detector sees no 40 KHz signal. Whenever the module detects the 40 KHz IR light, it pulls its output lead low, causing your robot's computer to read a logic 0.

In general, using these IR detectors seems straightforward, but a few traps await the unwary putting one of these subsystems together for the first time. The single most important detail involves the metal case of the IR detector module. *You MUST connect this case to ground!* If you don't tie the case to ground, your detector will never give consistent, reliable signals. Also remember that the module has an open-collector output; you must connect the output lead to a pull-up resistor of about 10K ohms or the computer will see garbage on the input line connected to the module.

The IR modules are quite sensitive, and you can overdrive them easily if you run too much power through your IR LEDs. If you get your object detection system aligned, but get lots of false positives (the computer "sees" an object when none is there), you might be driving the LED too hard. Generally, an LED current of one to two mA will give you plenty of range with the newer, high-output LEDs. This translates to a dropping resistor of about 2K ohms for an LED hooked to a +5 VDC supply. Start out using a dropping resistor in this range, then decrease the resistance, if necessary.

One of the most frustrating aspects of using IR for object detection deals with IR transparency. Many materials that look opaque to you are nearly invisible in the IR wavelengths, and such materials make lousy light shields if you need to protect your IR module from stray 40 KHz light. Brass tubing, aluminum foil, and other metallic materials make good light shields, but they can prove tough to work with. One solution — used here — is to mount the IR detectors on the underside of the base and the IR emitters on the upper side; this lets the base act as a large IR shield.

Finally, you will probably need to protect your IR detector from stray sunlight or ambient light from some of the high-power indoor lighting; the sodium-vapor lights in particular can cause lots of interference. You can make a cheap and simple IR filter by cutting up some of the developed film leaders from old color-print negatives. These black film ends look opaque to you but are nearly transparent to IR. Glue or tape at least one piece of this film over the front of each IR module to cut down saturation from high-power light sources such as the sun.

With that IR primer out of the way, I can get back to my specific case. I started by wiring a single LED and dropping resistor to the TP2 output pin on my New Micros 68332 board. I also hooked up one of the IR detectors, wired as shown in the accompanying schematic. For test purposes, I replaced the 10K ohm resistor shown here with a high-output green LED and 2.2K ohm dropping resistor.

Whenever the IR detector sees a 40 KHz signal, it pulls the output line low and the tiny current through this LED gives just enough light to act as a visual signal. I wrote a little Forth code to

generate a 40 KHz square-wave of the proper duty-cycle on TP2, then verified that the detector's LED came on whenever I aimed the IR LED at it.

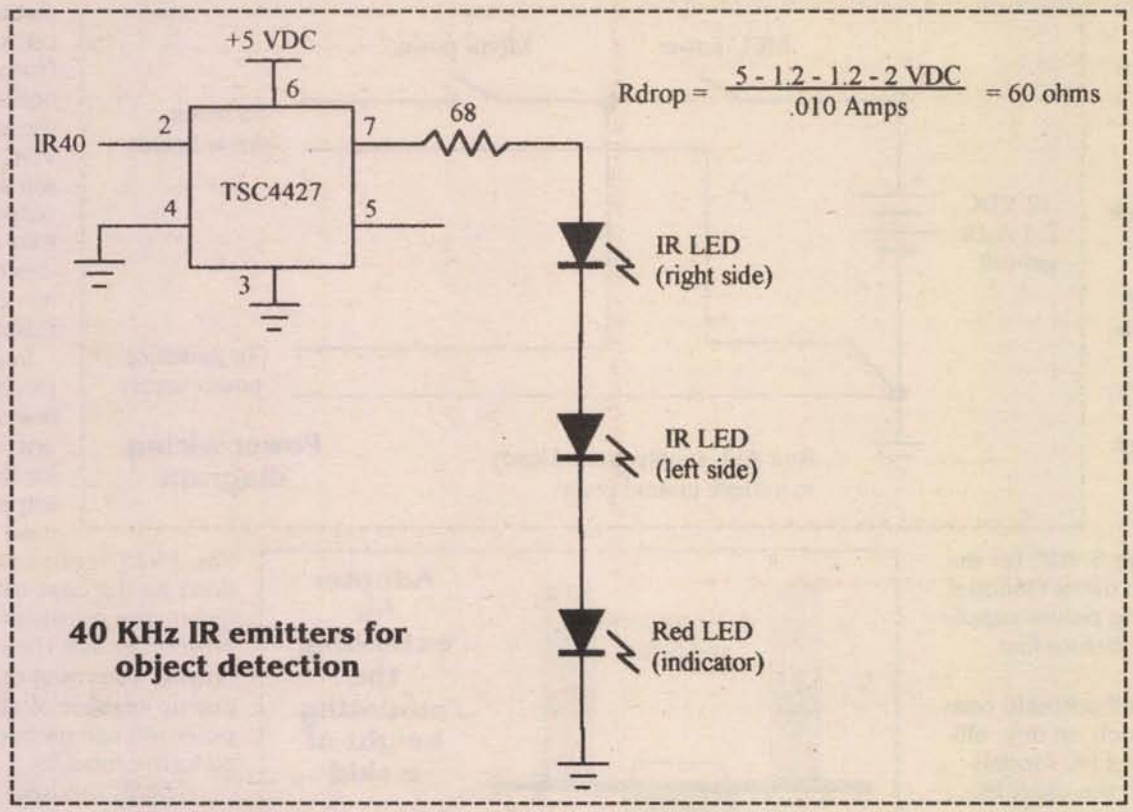
Unfortunately, the detector had pathetic range, far less than needed for reliable object detection. I double-checked my wiring and code, but everything looked good. Eventually, I decided the problem lay with the output capabilities of the 68332's TP2 line; perhaps I wasn't getting all of the output drive I needed. So just for grins, I grabbed the 68332 reference manual and took a look. What a bummer! The TP2 output line, like most 68332 outputs, can source only a very small current, on the order of one or two mA. Granted, I don't need much more than that, but I'm still on the borderline with my design, and if I ever decide I need a bit more juice, I won't get it by directly driving with the 68332 output.

This mistake falls under the "it always worked before" category. The 68hc11 can drive substantial amounts of current through its output lines. I'm so used to wiring LEDs directly to the 'hc11's output pins that I never thought twice about doing the same thing to the 68332. Just goes to show you ...

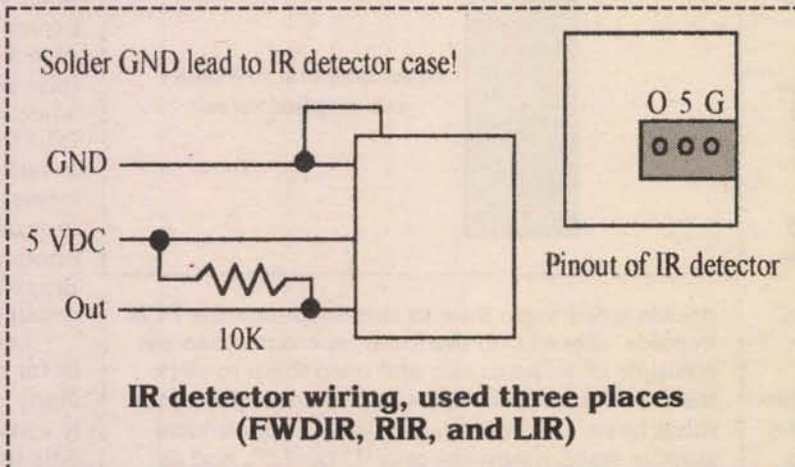
This finding led to the schematic you see here for the 40 KHz IR emitters. The TSC4427, available from many large mail-order houses — including Digi-Key — is an eight-pin H-bridge MOSFET IC that is so mind-bogglingly useful that you should keep a dozen or so laying around at all times. One of these devices can supply up to 600 mA through each of its two outputs, and you can build an H-bridge driver for small motors using nothing more than this IC and a couple of output lines from your MCU.

Even better, you can get even more drive out of these devices simply by stacking a second chip on top of the first and soldering the matching leads together. Be sure you wire any unused input to ground, to minimize current draw; note my hookup on pin 4.

The TSC4427 has no problems supplying the scant current requirements of my IR LEDs. As you can see here, I've included a third LED, red in this case, to act as an indicator that the 40 KHz output is on. I've also given the formula used to derive the value of the dropping resistor. As shown, the formula assumes 10 mA of current through two IR LEDs with a forward drop of 1.2 VDC and a single red LED with a forward drop of 2 VDC. If you decide to dump the indicator LED or change its color, plug the appropriate voltages back into the formula, and re-calculate the value for the dropping resistor.



40 KHz IR emitters for object detection



IR detector wiring, used three places (FWDIR, RIR, and LIR)

The house on fire

Besides building a robot to run in the upcoming Northwest Regional Fire-fighting contest, I'm also helping to build the model house that will serve as the arena for this event. Keith Payea, one of the SRS' top electron wranglers, is in charge of the construction, and several other SRS members showed up one Saturday to start construction. Keith had already purchased two sheets of 4' x 8' tongue-and-groove 3/4" plywood, to serve as a floor. The tongue-and-groove construction will minimize any problems we might have with the seam down the center of the floor; no point having a robot trip over a crack in the floor.

The walls for this arena must be 13" high, and there are several walls. Rather than spend a bunch more of the club's precious dollars on more plywood, Keith elected to rip up some walls left over from the club's Grand Maze arena. The Grand Maze, long the club's signature event, uses lots of plywood walls 2' high; a few less walls wouldn't be noticed.

So one cold, rainy Saturday afternoon, Frank Haymes, Keith, and I got together in Keith's garage to begin the construction of our new robot house. First off, we rooted through the stack of Grand Maze walls, selecting walls of the proper length, giving preference to those carrying the fewest slugs and giant spiders. Using the contest layout provided by Trinity College — the official organization behind this event — Keith measured and marked the pieces we needed to cut. Next, we rev'ed up Keith's table saw and ripped the selected walls to the proper width, then cut these pieces to the required lengths.

The Grand Maze walls already had two coats of gloss paint, in various bright primary colors, so they needed a couple of layers of flat white paint on them before they would be legal. I used a small orbital sander to rough up the surfaces, then Frank slathered on the first coat of paint. Even before the paint dried, the results looked promising. We weren't able to finish all of the painting that day, but we're encouraged.

The closest I've come to seeing a finished Fire-fighting maze is viewing the videos of the 1995 and 1996 events, kindly provided to me by Jake Mendelssohn. The videos showcase some of the more interesting robots from those two years, and I caught glimpses of the house construction throughout the event. The builders of the Trinity College house look to have done an excellent job, using rounded metal angle brackets at the top of each wall junction.

These videos provided peeks at some truly excellent robot designs. One of the most entertaining entries in the 1995 contest — named Pop Goes the Weasel — sported a long, brightly colored inflated balloon. When the Weasel located the candle flame, it glided forward until the flame touched the balloon, which promply burst. The sudden explosion of air not only snuffed out the flame, but gave the crowd a thrill at the same time.

Another entry I really liked — winner of the Senior division of the 1995 event — was built by David Otten. His machine was about the size and outline of a roller-blade, and the whole design and operation was very business-like. His robot methodically motored from room to room, taking one quick glance into each from the doorway. When it found the room with the lit candle in it, the robot turned on a top-mounted fan and advanced on the flame until the wind put out the fire.

David's clean design and no-nonsense approach to the problem impressed me very much. I can recommend purchasing the 1995 video from Trinity College as case studies in two excellent robot designs, and as a way to view several other good robots. Trinity College sells the 1995 and 1996 video tapes for $25.00 each; check their web site at www.trincoll.edu/~robot for details on ordering your tapes. NOTE: Do NOT send them checks made out to Trinity College! Review the web site for information before sending any money! **NV**

As always, you can reach me at:
Karl Lunt
116 173rd St. S.W., Bothell, WA 98012
E-Mail: karllunt@seanet.com
Web: http://www.seanet.com/~karllunt

Events CALENDAR

Continued from page 93

NJ - HARMONY TOWNSHIP - Cherryville Repeater Assn. Hamfest. Marty Grozinski W2CG, 908-788-2644, 908-788-4080
OR - KLAMATH FALLS - Keno ARC Hamfest. Tom Hamilton WD6EAW. 541-883-2736. E-Mail: wjonesjr@cdsnet.net Web: http://home.cdsnet.net/~wjonesjr/kenoarc.htm
PA - BLOOMSBURG - Columbia-Montour ARC Hamfest. Dave Schack WC3A. 717-752-6851

APRIL 26

IL - ARTHUR - Moultrie ARK Hamfest. Ralph Zancha WC9V, 217-873-5287 or 217-543-2178
IL - GLEN ELLYN - Computer Show & Sale. College of DuPage. Main Arena of Phys Ed Bldg. Corner of Park Blvd. & College Rd. 9:30am-3pm. Computer Central Shows 847-940-7547
OH - CANFIELD - Hamfest & Computer Flea Market. Canfield Fairgrounds, Rt. 46. 8am-3pm. Don Stoddard N8LNE, 330-793-7072

MAY 1998

MAY 2

AZ - SIERRA VISTA - Cochise ARA & SE Hamfest. Ronald Slominski KC7QXJ. 520-378-3018
CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
KY - OWENSBORO - ARC Hamfest. George Stokes KD4CKT, 502-683-2169. E-Mail: w4nho@occ-uky.campus.mci.net
WI - CEDARBURG - Ozaukee RC Hamfest. Gabe Chido, 414-377-2784 or 414-284-3271

MAY 3

CA - LIVERMORE - Swapmeet. Las Positas College. Noel Anklam 510-447-3857
MD - HAGERSTOWN - Hamfest. Junior College Athletic and Recreation Community Center. 8am-3pm. Donald Jones KB8WHW, 304-728-7769. E-Mail: kb8zqm@intrepid.net
NY - YONKERS - Flea Market. Lincoln High School. Kneeland Ave. 9am-3pm. Otto Supliski WB2SLQ. 914-969-1053
PA - WRIGHTSTOWN - Warminster ARC Hamfest. Tony Simek N3YNH, 215-674-5218
WV - RIPLEY - Jackson Co. ARC Hamfest. Gary Casto AG8RY, 304-372-2849

MAY 8-9

NH - ROCHESTER - HOSSTRADERS Hamfest. Joe Demaso K1RQG. 207-469-3492. E-Mail: k1rqg@aol.com

MAY 9

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves

MAY 15-16-17

OH - DAYTON - HamVention. Dick Miller N8CBU, 937-276-6930. E-Mail: chair@hamvention.org Web: http://www.hamvention.org/

MAY 16

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

MAY 17

MA - CAMBRIDGE - Flea Market. Kendall Square area. MIT. Nick Alternbernd KA1MQX, 617-253-3776
MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988

MAY 29-30

NE - SOUTH SIOUX CITY - Midwest/Dakota Div. Convention. Mike Nickolaus NF0N, 402-494-6070. E-Mail: nf0n@avalon.net Web: http://www.pionet.net/~k0brd/hamboree/

MAY 29-30-31

NY - ROCHESTER - Atlantic Division Convention. Harold Smith K2HC. 716-424-7184. E-Mail: rochfst@frontiernet.net Web: http://www.rochesterhamfest.org
OR - SEASIDE - Northwestern Division Convention. Randy Stimson KZ7T. 503-297-1175

MAY 30-31

OR - SEASIDE - SEAPAC Ham Conv. Seaside Convention Center. Randy Stimson KZ7T, 503-297-1175

MAY 31

CA - SANTA ANA - Swapmeet. ACP parking lot. Mary Russo 714-558-8813
IL - GLEN ELLYN - Computer Show & Sale. College of DuPage. Main Arena of Phys Ed Bldg. Corner of Park Blvd. & College Rd. 9:30am-3pm. Computer Central Shows 847-940-7547

JUNE 1998

JUNE 6

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

JUNE 7

CA - LIVERMORE - Swapmeet. Las Positas College. Noel Anklam 510-447-3857
IL - PRINCETON - Starved Rock RC Hamfest. Debbie Burton N9DRU, 815-795-2201
VA - MANASSAS - Ole Virginia Hams ARC Hamfest. Mary Lu Blasdell KB4EFP, 703-369-2877

JUNE 12-13

GA - ALBANY - ARC Hamfest. Arthur Shipley N4GPJ, 912-439-7055

JUNE 13

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves

JUNE 14

IL - WHEATON - Six Meter Club of Chicago Hamfest. Joseph Gutwein WA9RIJ, 630-963-4922
KY - ERLANGER - Northern Kentucky ARC Hamfest. Robert Blocher N8JMV, 513-797-7252
MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988
NY - BETHPAGE - Long Island Mobile ARC Hamfest. Richie Selzer N2WJL, 516-520-9311. E-Mail: n2wjl@juno.com

JUNE 19-20-21

GA - ATLANTA - Hamfestival '98. Greg Barrett N5BDJ, 770-649-1467. E-Mail: gbjb@mindspring.com Web: http://www.saf.com/arc

JUNE 20

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
NJ - DUNELLEN - Raritan Valley RC Hamfest. Doug Benner WB2NJH, 908-469-9009. E-Mail: wb2njh@aol.com
WV - BLUEFIELD - East River ARC Hamfest. Don Williams WA4K, 540-326-3338. E-Mail: WA4K@AMSAT.ORG

JUNE 21

MA - CAMBRIDGE - Flea Market. Kendall Square

Continued on page 100

New Product News

Our readers are always looking for new and interesting electronic items. Showcase your NEW PRODUCTS here to help stimulate your product's success. Submit all news releases, product information, and/or photos to:

NUTS & VOLTS MAGAZINE
NEW PRODUCT EDITOR,
430 PRINCELAND CT., CORONA, CA 91719

O-SCOPE II WINDOWS

ATC announces the O-Scope II Windows release. Now the O-Scope II digital storage oscilloscope module has both DOS and Windows operating programs.

The O-Scope II converts a PC into an advanced digital storage oscilloscope and data logger. It provides oscilloscope, voltmeter, and frequency spectrum analyzer functions suitable for many applications.

Data may be captured to disk or transferred to other Windows programs. Display screen data may be captured graphically for printouts or may be converted to graphic images.

The modules are small, low cost, and lightweight, making them suitable for portable operations, as well as for the crowded work bench.

The O-Scope II works with standard scope probes and is powered from 12 VDC.

ATC offers a variety of probes for the unit, including standard attenuating probes, high-voltage probe, differential probes, and automotive ignition probes.

The O-Scope II sells for $349.00 including the module, manuals, AC power adapter, cable, and both the Windows and DOS software packages.

For more information, contact:

ALLISON TECHNOLOGY CORPORATION
8343 CARVEL, DEPT. NV
HOUSTON, TX 77036-6301
713-777-0401 FAX: 713-777-4746
1-800-980-9806

SPECTRUM

ATC announces Spectrum, a low-cost accessory program which allows a PC to do spectrum analysis on live data using the O-Scope I or O-Scope II digital storage oscilloscope modules.

Spectrum also works with O-Scope II data log formatted records.

Spectrum uses Fast Fourier Transform, FFT, calculations to determine the frequency spectrum content of the incoming waveform.

Spectrum provides many enhancements over the built-in 256 point FFT provided with the standard O-Scope software. These enhancements include the ability to display either linear or logarithmic power and frequency axes, a choice of FFT windowing functions, a variety of FFT sizes, up to 8192 FFT points, and the ability to display FFT relative phase information.

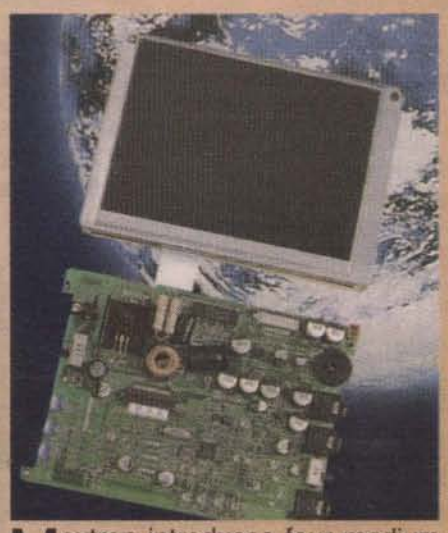
Spectrum runs under DOS and provides a live graphics view in real time. It can log spectral information to disk in a form suitable for use by other programs.

Spectrum sells for $39.00 and requires either the O-Scope I or O-Scope II module for live data processing.

For more information, contact:

ALLISON TECHNOLOGY CORPORATION
8343 CARVEL, DEPT. NV
HOUSTON, TX 77036-6301
713-777-0401 FAX: 713-777-4746
1-800-980-9806

4"-6" TFT LCD MONITOR/MODULES



Maxtron introduces four medium sizes (4", 5", 5.6", 6.4" diagonal) active Matrix TFT color LCD monitor/modules powered by 12 volts DC with composite video input.

The display features small size, high contrast, bright CCFT backlight, wide viewing angle, and low-power consumption.

The resolutions are 480x234, 600x234, 720x234, and 960x234, respectively.

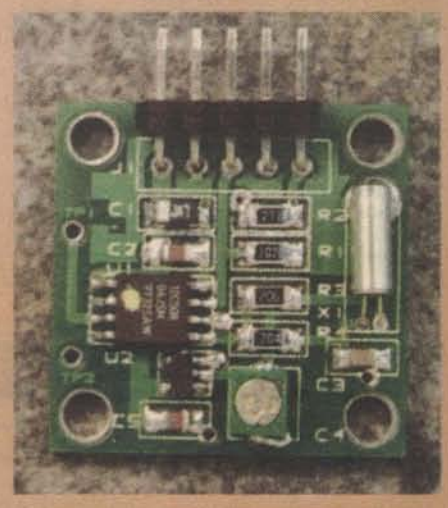
The features of the display lend themselves to the applications of vehicle GPS, car TV, security products, instrumentation, etc.

The monitor has an optional stand for dashboard mounting. A TV tuner with infrared control is also available.

For more information, contact:

MAXTRON
11135 E. RUSH ST. #R, DEPT. NV
S. EL MONTE, CA 91733
1-800-COOLS0N
626-350-5706 FAX: 626-350-4965
E-MAIL: maxtron@earthlink.net

POCKET WATCH B



The Pocket Watch B contains a real-time clock, calendar, and advanced timing features.

The clock module keeps track of seconds, minutes, hours, days, months, and years. Adjustments for leap year are automatically performed. It's also year 2000 compatible.

This real-time clock communicates via an easy-to-use, asynchronous, one or two wire, serial communications interface. Baud rates of 2.4K, 4.8K, and 9.6K are supported with a user-friendly automatic baud detect system.

System timing functions can easily be implemented with any of the four advanced alarm types. There is a standard level alarm, a single shot alarm, and two alarms with variable output pulse duration and repetition rates.

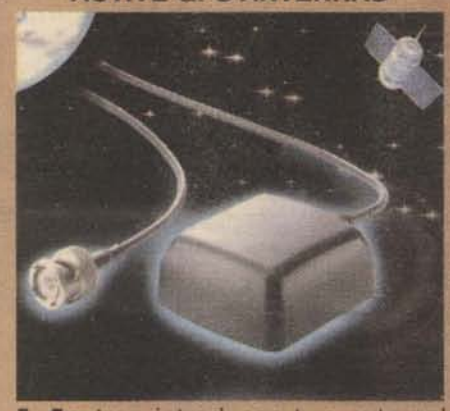
The Pocket Watch B's small size and connection scheme allow the device to be inserted directly into circuit boards for production runs, or into breadboards for easy prototyping. Complete data sheets and application notes are available at "www.solutions-cubed.com"

The Pocket Watch B comes in a 1" x 1" SIP module, and sells for $24.95.

For more information, contact:

SOLUTIONS CUBED
3029 ESPLANADE STE. F
DEPT. NV
CHICO, CA 95973
530-891-8045 FAX: 530-891-1643
E-MAIL:
lon@solutions-cubed.com
URL:
www.solutions-cubed.com

1" & 2" EXTERNAL ACTIVE GPS ANTENNAS



Maxtron introduces two external GPS antennas with an active amplifier built-in.

Each has a typical gain of 27 dB, magnetic-based, BNC connector with power sent through the BNC connector as well.

The applications are to enhance reception for various GPS receivers with no external antenna or replacement external antenna.

Optional connector is also available.

The general specifications are: 1.575 GHz, >-4 dBic gain coverage, RHCP polarization, 1-watt power, 1.2 dB noise figure, 3- or 5-volt DC at 25 mA, five meters of RG174 cable, -40C to 85C operation temperature.

For more information, contact:

MAXTRON
11135 E. RUSH ST. #R, DEPT. NV
S. EL MONTE, CA 91733
1-800-COOLS0N
626-350-5706 FAX: 626-350-4965
E-MAIL: maxtron@earthlink.net

HOT STAMP MARKERS

IPC Hot Stamp Markers are custom-made from a wide range of heat shrinkable materials and hot

New Product News

stamped using a dry process which produces smudge-resistant logos, part numbers, date codes, and serial numbers. Ideal for identifying, protecting, and finishing products, imprint sizes can vary from 1/16" sq. up to 2" x 4".

Featuring more than 25 imprint colors in stock with matte and glossy finishes, IPC Hot Stamp Markers can be manufactured from PVC, polyolefin, Kynar®, Mylar®, Viton®, and neoprene. Capable or imprinting both sides simultaneously, these identification markers can be cut to length and meet MIL specifications.

For more information, contact:

INSULATION PRODUCTS CORP.
2550 WISCONSIN AVE., DEPT. NV
DOWNERS GROVE, IL 60515
630-512-9600 FAX: 630-512-9607

50-OHM TOGGLE SWITCH ATTENUATOR

RF Connectors announces the release of a new RFA-4056-03 BNC toggle switched attenuator.

The attenuation range is 0-31 dB in 1 dB steps, and the frequency range is DC to 1000 MHz. The attenuation steps are 1, 2, 4, 8, and 16 dB with attenuation accuracy of ± .2 dB per step at DC to 500 MHz and ± .3 dB per step at 501 to 1000 MHz. Insertion loss is 1 dB maximum and the maximum SWR is 1.4:1.

For more information, contact:

RF CONNECTORS
7610 MIRAMAR RD., DEPT. NV
SAN DIEGO, CA 92126-4202
619-549-6340 FAX: 619-549-6345
1-800-233-1728
E-MAIL: rfi@rfindustries.com

POWERPORT 259

Cutting Edge introduces a new portable power supply to meet the need. PowerPort 259 supplies up to 500 watts to start heavy loads, with a continuous output of 250 watts at 115 volts AC. On the DC power side, it will provide up to 20 amps. Two AC and one DC outlet, make several tools or lighting combinations available to you at once.

Hand portable and compact (4.25" x 4.5" x 6"), this system is based on a 12-volt, 9-amp hour power cell and weighs only nine pounds.

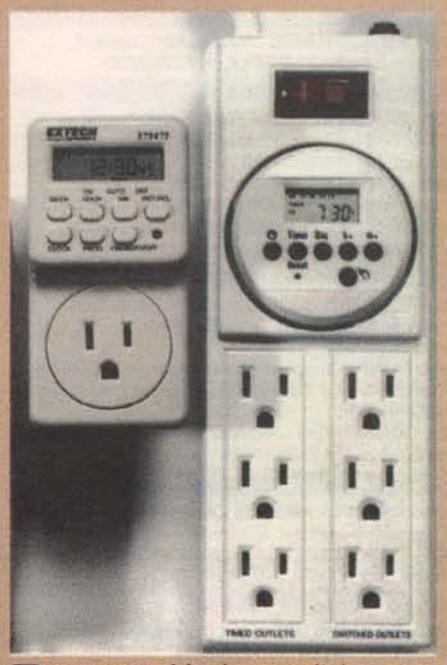
PowerPort can be charged in your vehicle through the cigarette lighter without requiring the engine to be running. It is also equipped with a fully automatic wall charger which can be left plugged in without the fear of overcharging your battery.

The PowerPort 259 is the perfect device for running and charging small hand tools (drills, routers, Dremel tools etc.) small motor machines such as sewing machines or fans, TVs, VCRs, handheld radios test equipment, emergency lighting, handheld GPS receivers, laptop computers, video cameras, fax machines, and more in the field.

For more information, contact:

CUTTING EDGE ENTERPRISES
1803 MISSION ST., STE. 546
DEPT. NV
SANTA CRUZ, CA 95060
1-800-206-0115
E-MAIL: cutedgent@aol.com

PROGRAMMABLE TIMER SWITCHES



Programmable timer switches program up to six-on and six-off switchings per day or week. Program for individual days, Mon-Fri, Mon-Sat, Mon-Sun, or Sat-Sun.

The switches include a built-in clock with a one-year battery back-up.

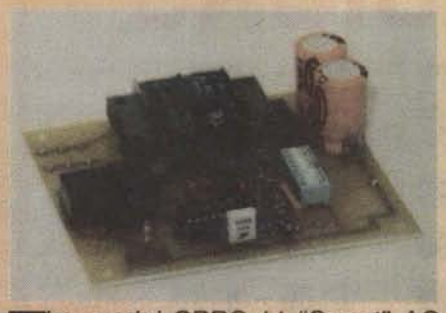
The plug-in model offers a single three-prong outlet and hangs from the wall outlet. The strip model is surge-protected and offers six three-prong outlets with a four-foot cord.

Both models operate on 115 VAC, 60 Hz only.

For more information, contact:

JENSEN TOOLS
7815 S. 46TH ST., DEPT. NV
PHOENIX, AZ 85044
602-968-6231 FAX: 602-438-1690
1-800-426-1194
E-MAIL:
jensen@stanleyworks.com
WEB:
http://www.jensentools.com

SPPC-11 SMART AC MAINS VOLTAGE PROTECTOR



The model SPPC-11 "Smart" AC mains voltage protector monitors the power line and disconnects the load if the voltage goes outside the programmed limits.

The SPPC-11 is DIP-switch user-programmable for center voltages of 208, 220, 230, and 240 volts, 50 or 60 Hz. It is also DIP-switch user-programmable for high/low protection limits of 30, 26, 22, and 19 percent of center voltage.

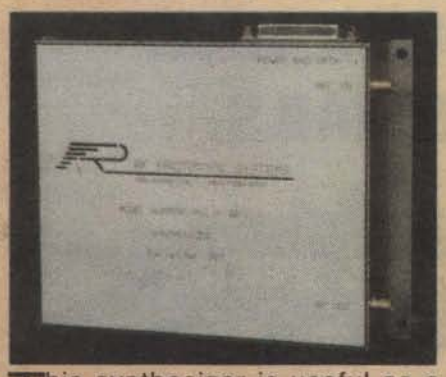
A rechargeable NiCd battery is not needed for this model protecter.

Single quantity price is $38.00

For more information, contact:

TDL® TECHNOLOGY, INC.
5260 COCHISE TRL., DEPT. NV
LAS CRUCES, NM 88012-9736
505-382-3173 FAX: 505-382-8810
WEB: www.zianet.com/tdl

MICROWAVE SYNTHESIZER



This synthesizer is useful as a local oscillator for satellite upconverters or low-cost test sources.

It has a wide output bandwidth range of 2600 to 4750 MHz.

The output power is typically +12 dBm, and accepts a 10 MHz reference input.

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The Real Logic Analyzer (RLA) is an essential tool for anyone testing or troubleshooting digital circuits.

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Just plug your two-meter handheld radio into the PowerPort RF-35, grab the carrying strap, and take it with you wherever you go. You no longer need separate set-ups for your car, your home, or out in the field. The RF-35 is fully self-contained with its own highly portable power supply that gives you 35 watts wherever you are.

The rechargeable PowerPort RF-35 by Cutting Edge Enterprises amplifies your signal to 35 watts. With nine-amp hours of on-board 12 VDC power, you can maintain communications all day, anywhere, with-

Continued on page 104

Events CALENDAR

Continued from page 97

area. MIT. Nick Alternbernd KA1MQX, 617-253-3776
MD - FREDERICK - ARC Hamfest. Eric Gammeter N8AAY, 301-865-0865
MI - MONROE - Monroe Co. Radio Comm. Assn Hamfest. Fred VanDaele KA8EBI, 313-242-9487
OH - MACEDONIA - Cuyahoga ARS Hamfest. Rich James N8FIL, 1-800-404-2282. http://www.cars.org

JUNE 28

IL - GLEN ELLYN - Computer Show & Sale. College of DuPage. Main Arena of Phys Ed Bldg. Corner of Park Blvd. & College Rd. 9:30am-3pm. Computer Central Shows 847-940-7547

JULY 1998

JULY 4

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

JULY 5

PA - WILKES-BARRE - Murgas ARC Hamfest. Robert J. Michael WB3FAA, 717-288-3532

JULY 11

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves
MO - KANSAS CITY - PHD ARA Hamfest. Bob Roske WA0CLR, 816-436-0069. E-Mail: wa0clr@juno.com Web: http://www.tfs.net/~caltman/phdara/phdara.htm

JULY 12

IL - PEOTONE - Kankakee ARS Hamfest. Don Kerouac K9NR, 815-939-7548. E-Mail: k9nr@juno.com
MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988
PA - KIMBERTON - Mid-Atlantic ARC Hamfest. Bob Haase W3SA, 610-293-1919

JULY 18

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
TX - TEXAS CITY - Tidelands ARS Hamfest. Carl W. Steele Jr. WA5WVP, 409-948-0308

JULY 19

MO - WASHINGTON - Zero Beaters ARC Hamfest. Keith Wilson K0ZH, 314-629-2264
NY - FARMINGVILLE - Radio Central ARC Hamfest. Jo Ann Colletti N2IME, 516-399-1877. Web: http://www.li.net/~n2mdq
OH - VAN WERT - ARC Hamfest. Louie Thomas WD8LLO, 419-238-2812. E-Mail: barnesrl@bright.net Web: http://www.bright.net/~barnesrl/w8fy.htm

JULY 24-25-26

AZ - FLAGSTAFF - AZ State Convention. Mark Kesauer N7KKQ, 602-440-2039

JULY 24-25

FL - MILTON - Milton ARC Hamfest. Mark McAnally KE4QKN, 850-626-7686. E-Mail: KE4QKN@AOL.COM
OK - OKLAHOMA CITY - OK State Convention. Harold Miller KB1ZQ, 405-672-7735. E-Mail: n11pn@swbell.net

JULY 25

NC - WAYNESVILLE - Western Carolina ARS Hamfest. Thomas Queen K4BNP, 704-258-2639
OH - CINCINNATI - OH-KY-IN ARS Hamfest. Dana Laurie WA8M, 513-761-7388

JULY 26

CA - SANTA ANA - Swapmeet. ACP parking lot. Mary Russo 714-558-8813
IL - GLEN ELLYN - Computer Show & Sale. College of DuPage. Main Arena of Phys Ed Bldg. Corner of Park Blvd. & College Rd. 9:30am-3pm. Computer Central Shows 847-940-7547

AUGUST 1998

AUGUST 1

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
KY - BOWLING GREEN - KY Colonels ARC Hamfest. Leon Garrett K4CIT, 502-842-5307
NC - HIGH POINT - ARC Hamfest. Mark McMahan KB4MFP, 910-887-3039
OH - COLUMBUS - Voice of Aladdin ARC Hamfest. Jim Morton KB8KPJ, 614-846-7790

AUGUST 8

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves

AUGUST 15

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052
GA - ALBANY - Computer & Electronics Expo. Hasan Temple, 1822 Palmyra Rd. 9am-5pm. Sandy Rabb 912-888-9393. E-Mail: GODS@SURFSOUTH.COM

AUGUST 16

MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988

AUGUST 23

IL - GLEN ELLYN - Computer Show & Sale. College of DuPage. Main Arena of Phys Ed Bldg. Corner of Park Blvd. & College Rd. 9:30am-3pm. Computer Central Shows 847-940-7547

SEPTEMBER 1998

SEPTEMBER 5

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

SEPTEMBER 12

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves

SEPTEMBER 13

IL - GLEN ELLYN - Computer Show & Sale. College of DuPage. Main Arena of Phys Ed Bldg. Corner of Park Blvd. & College Rd. 9:30am-3pm. Computer Central Shows 847-940-7547
MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988

SEPTEMBER 19

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

SEPTEMBER 27

CA - SANTA ANA - Swapmeet. ACP parking lot. Mary Russo 714-558-8813
NY - YONKERS - Flea Market. Lincoln High School. Kneeland Ave. 9am-3pm. Otto Supliski WB2SLQ. 914-969-1053

OCTOBER 1998

OCTOBER 3

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

OCTOBER 10

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves

OCTOBER 11

MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988

OCTOBER 17

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

OCTOBER 18

IL - PALATINE - Computer Show & Sale. Harper College. Bldg. M (Phys Ed Bldg.). Roselle & Algonquin Rds. 9:30am-3pm. Computer Central Shows 847-940-7547

OCTOBER 25

IL - GLEN ELLYN - Computer Show & Sale. College of DuPage. Main Arena of Phys Ed Bldg. Corner of Park Blvd. & College Rd. 9:30am-3pm. Computer Central Shows 847-940-7547

NOVEMBER 1998

NOVEMBER 7

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

NOVEMBER 7-8

MO - ST. CHARLES - Computer Show & Sale. St. Charles Exposition Hall, St. Charles Center, I-70 & 5th St. Sat: 10am-4pm, Sun: 11am-3pm. Computer Central Shows 888-296-6066. E-Mail: computershow.chicago@mcimail.com

NOVEMBER 14

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves

NOVEMBER 21

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

NOVEMBER 27-28

MI - FLINT - Computer Show. Holiday Inn, Gateway Centre, US 23 @ Hill Rd. Exit. Five Star Productions 810-890-0988

NOVEMBER 29

CA - SANTA ANA - Swapmeet. ACP parking lot. Mary Russo 714-558-8813
IL - GLEN ELLYN - Computer Show & Sale. College of DuPage. Main Arena of Phys Ed Bldg. Corner of Park Blvd. & College Rd. 9:30am-3pm. Computer Central Shows 847-940-7547

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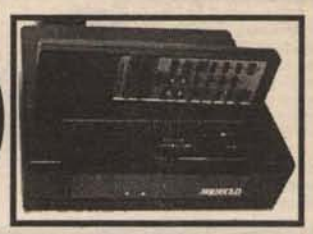

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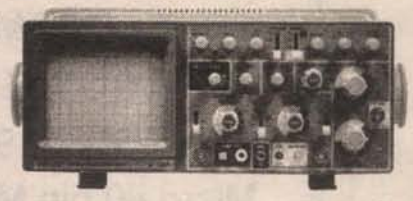

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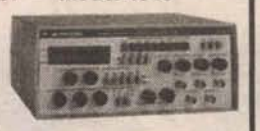

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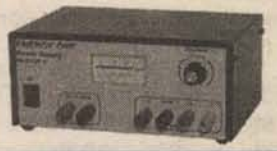

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Continued from page 99

New Product News

out a break to recharge.

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If you can't talk quite that long and want something even more lightweight, the RF-35 Jr. (at three pounds and 2.3 amp hours of DC power) will still give you .75 hours of solid talk and unlimited standby.

Its sturdy carrying bag makes transport a snap. The RF-35 also has removable side pockets to hold your HT and accessories, keeping all your communications gear compact and hand portable.

This unit is ready to go, right out of the box. It is fully charged, comes with RG-174/U minicable with BNC connector for your HT, and a mini "j" antenna on 10' of cable (3 dB gain and 14' tall) is tucked into one of the accessory pockets for your convenience.

For more information, contact:

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BPECS32™: Best Proto Electronics CAD System — 32- bit version.

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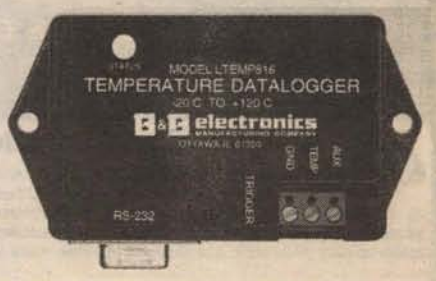

Less than 1" thick and 4" long, and weighing just 4 ounces, Model LTEMP816 from B&B Electronics, provides an inexpensive way to record temperatures between -20°C and 120°C (0° to 250°F). An external 10ΩK thermistor is included.

Typical applications would be checking shipping and storage conditions or monitoring temperatures in industrial, commercial, or research processes.

No external power is required; a replaceable lithium battery is included. Easy-to-use software to adjust, download, and reset the module is included. Cost is $114.95 for the module, software, and external thermistor probe.

For more information, contact:

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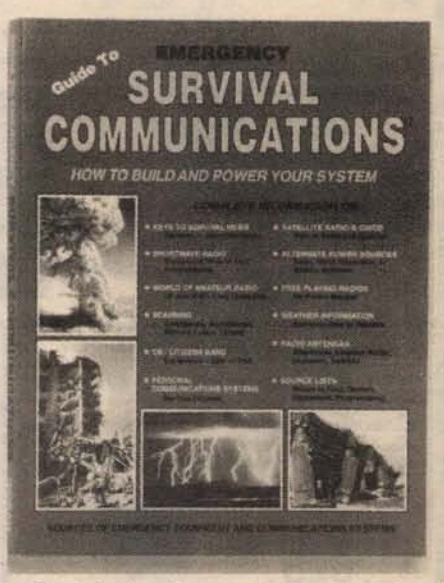
GUIDE TO SURVIVAL COMMUNICATIONS



Guide to Emergency Survival Communications is the first complete, up-to-date book dealing with the most important area of preparedness — SURVIVAL COMMUNICATIONS. The ability to receive accurate and timely information in a time of crisis can be lifesaving!

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Survival Communications shows

Continued on page 109

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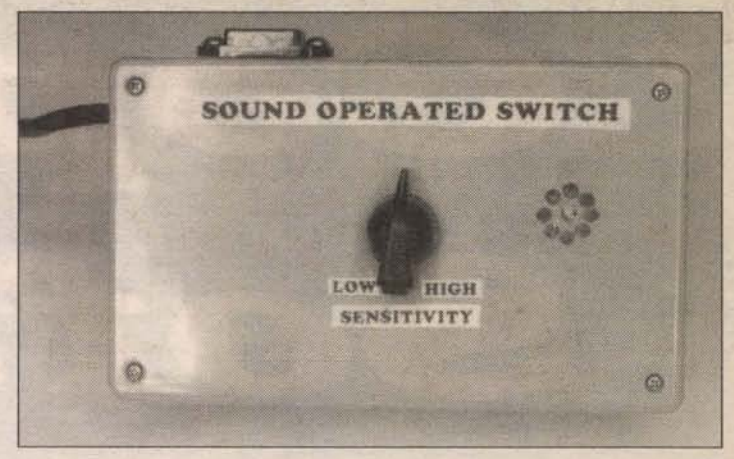
Build a Sound-Operated AC Switch

by Fred Blechman



Plug any resistive 120VAC device that uses up to 300 watts (such as a table lamp) into the Sound-Operated AC Switch socket. With each clap of your hands, the device will toggle ON or OFF. Powered by the wall socket, no battery is required. It can be built from parts or from a $13.95 kit. An appropriate cabinet is available for $3.75.

We've all had the experience of entering a dark room and hunting for the light switch somewhere on the wall. Or entering a dark room where the light switch is somewhere on a lamp inside the room, so we must carefully walk through the room, headed for the lamp, then grope around feeling for the switch.

Over the years, various commercial devices have been available that would allow you to turn the lamp on or off by clapping your hands. Whatever happened to them?

I haven't seen one of these gizmos lately, and I needed one — so I built the Model 147P Sound-Operated Switch from Graymark. All parts, including an etched and drilled printed circuit board were included. I then packaged the unit in Graymark's Model 1503 Plastic Box & Cover. The result is shown in the photos.

Circuit Description

The schematic of the Sound-Operated AC Switch is shown in Figure 1. Four distinct circuits are involved: Power Supply, Comparator, Logic, and Control.

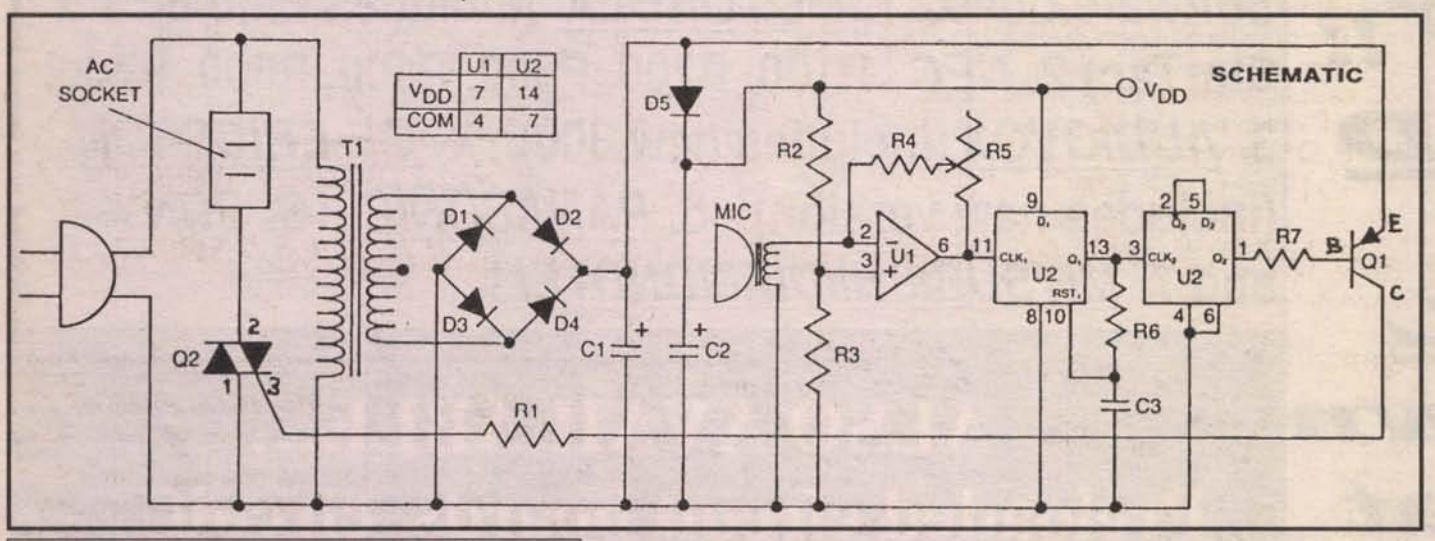


Figure 1: Sound-Operated AC Switch Schematic

Power Supply: The semiconductor circuits require less than 18 volts DC to operate. This could be done with batteries, which would require changing in time. Instead, since 120VAC is used for the output, it makes sense to use this source for power. Accordingly, transformer T1 steps down the 120VAC line voltage to about 12VAC.

This lower voltage is input to the bridge rectifier made up of silicon power diodes D1-D4. Opposite pairs (D1 and D4, D2 and D3) conduct on alternate half cycles, resulting in a pulsating direct current output from the bridge rectifier at the junction of D2 and D4. This is shown in Figure 2.

But this pulsating direct current output needs to be smoothed to maintain a relatively constant voltage. This is accomplished primarily with a fairly high capacity electrolytic capacitor, C1. During the time when the voltage is increasing, current flows into C1 and it charges. After the voltage crests and starts decreasing, current flows out of C1 as it discharges, tending to maintain voltage to the rest of the circuit.

In this manner, C1 fills the gaps between the voltage peaks, as shown in Figure 3. This process is called "filtering," and the resulting small variation in voltage is called "ripple."

Another fairly high capacity electrolytic capacitor, C2, assists in this filtering by further smoothing out the ripple remaining from C1, as shown in Figure 4 — almost as smooth a direct current as a battery. This supply voltage is referred to as "Vdd" in Figure 1. Diode D5 is used to isolate Vdd from the output of the bridge rectifier before final filtering.

Comparator: Integrated circuit U1 is a 741 operational amplifier — a high gain amplifier with a differential input. It compares the voltage inputs at pins 2 and 3, and amplifies the differences as the output at pin 6. Resistor R4 and potentiometer R5 are part of a feedback loop that controls the voltage of pin 2 so that it is equal to pin 3 when there is just ambient noise. Resistors R2 and R3 form a voltage divider using the voltage at pin 3 as a reference voltage. This reference voltage sets the voltage at output pin 6 to idle at about 30% of Vdd, the supply voltage.

When sound reaches the crystal microphone (MIC) with sufficient volume, the positive voltage at pin 2 jumps higher than the reference voltage on pin 3. This difference is instantly amplified and inverted by the 741, causing the voltage at pin 6 to swing full negative.

When the sound stops, the voltage at pin 6 moves positive, providing a clock input to the logic circuit. The circuit parameters are designed to ignore random noise (such as speaking, or the sound from a TV set or radio), but respond to a strong, sharp change in sound, such as a hand clap.

Logic Circuit: Integrated circuit U2 is a 4013 "dual D flip-flop"

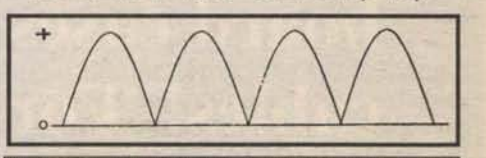


Figure 2: Pulsating direct current from bridge rectifier.

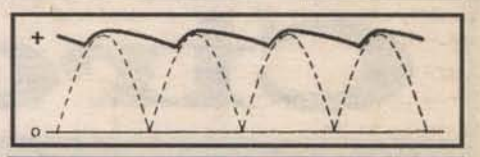


Figure 3: Capacitor C1 fills in the gaps.

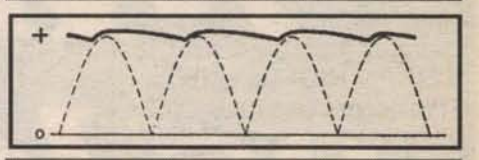


Figure 4: Capacitor C2 provides additional smoothing.

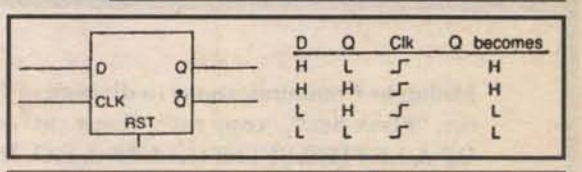


Figure 5: D flip-flop logic. Q follows D state.

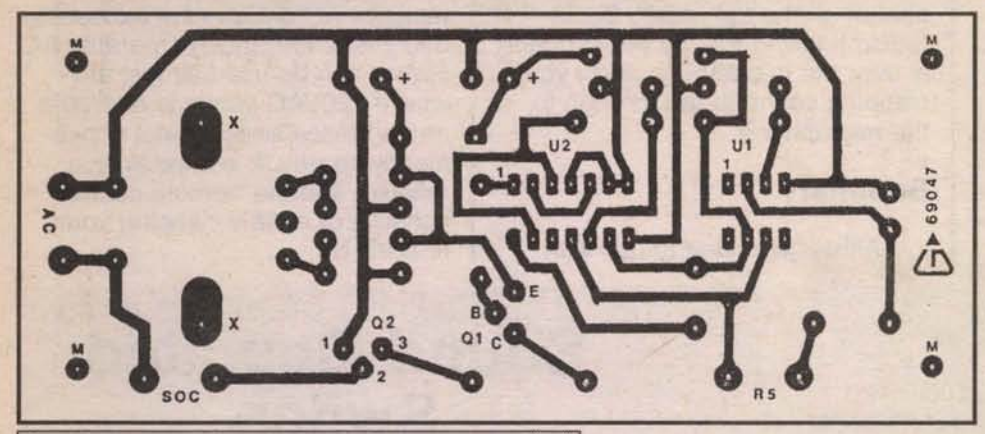


Figure 6: Printed Circuit Board Layout

containing two "D flip-flops." A D flip-flop is a logic circuit designed such that when the clock input changes, whatever logic level is at input "D" appears at output "Q," and the opposite state at output "not Q." (Not-Q is usually signified by a dot or line above the Q.) See Figure 5. The 4013 D, Q, and not-Q changes of state only occur during the positive transition of the clock pulse, when pin 6 of U1 goes positive.

In the Sound-Operated AC Switch, one flip-flop section is configured as a "one-shot," and the other section is configured as a "toggle" flip-flop. For the one-shot, pin 13 (Q1) is normally LOW. Pin 11 (CLK1) is triggered by the positive transition of pin 6 (U1) with a hand clap. This makes pin 13 (Q1) go to the same state as pin 9 (D1), which is always HIGH since it is connected directly to the supply voltage, Vdd.

Pin 13 going HIGH allows capacitor C3 to charge through resistor R6 until is reaches the threshold voltage to reset the flip-flip at pin 10 (RST1). This brings pin 13 back to LOW. This is necessary so that the one-shot is in a ready state for the next sound trigger. This is electronically equivalent to a normally-open momentary-contact push-button switch.

When pin 13 goes HIGH, it clocks pin 3 (CLK2). With each clock input, output pin 1 (Q2) changes from LOW to HIGH, or HIGH to LOW. This occurs because pin 5 (D2) is cross-coupled to pin 2 (not-Q2), forcing D2 to the opposite state of pin 1 every time pin 3 is clocked. This performs a binary divide function, and is electronically equal to a single-pole single-throw on-off switch.

Control Circuit: The output at pin 1 of the 4013 flip-flop is connected to the base of PNP transistor Q1 through current-limiting resistor R7. When pin 1 is LOW, Q1 conducts, allowing current to flow through current-limiting resistor R1 to the gate of triac Q2. A triac is an AC solid-state switch.

The presence of gate current switches the triac ON, allowing AC current to flow to the AC socket. When pin 1 of U2 goes HIGH, Q1 stops conducting, turning Q2 OFF. The current requirement to supply the gate of Q2 exceeds the amount U2 can supply by itself, so Q1 is used as a current amplifier.

Assembly

Figure 6 shows the printed circuit board layout and Figure 7 shows the parts layout for the Graymark kit. It's just a matter of following the excellent instructions. The etched and drilled printed circuit board makes assembly very quick and easy.

Take care that the polarity-sensitive parts (electrolytic capacitors, diodes, integrated circuits, transistor, and triac) are oriented properly, as shown in Figure 8. You won't need more than a 25-watt soldering iron, since none of the parts require greater heat.

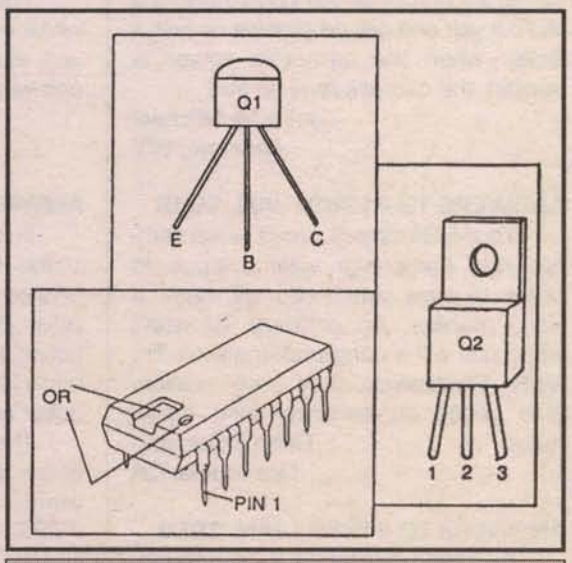


Figure 8: Lead Identification Pictorials

If you build from the kit, here are a few comments. I found the holes in the printed circuit board for the diodes and the AC power cord too small; you'll have to drill the diode holes out to about a 0.062 (1/16th) inch diameter and the power cord holes to a 0.078 (5/64ths) inch diameter. Mount the heatsink to the triac, Q2, BEFORE you mount Q2 to the board. The hole in the heatsink should mate with the hole in the Q2 metal tab. The kit includes solder — but not enough, so have some of your own on hand.

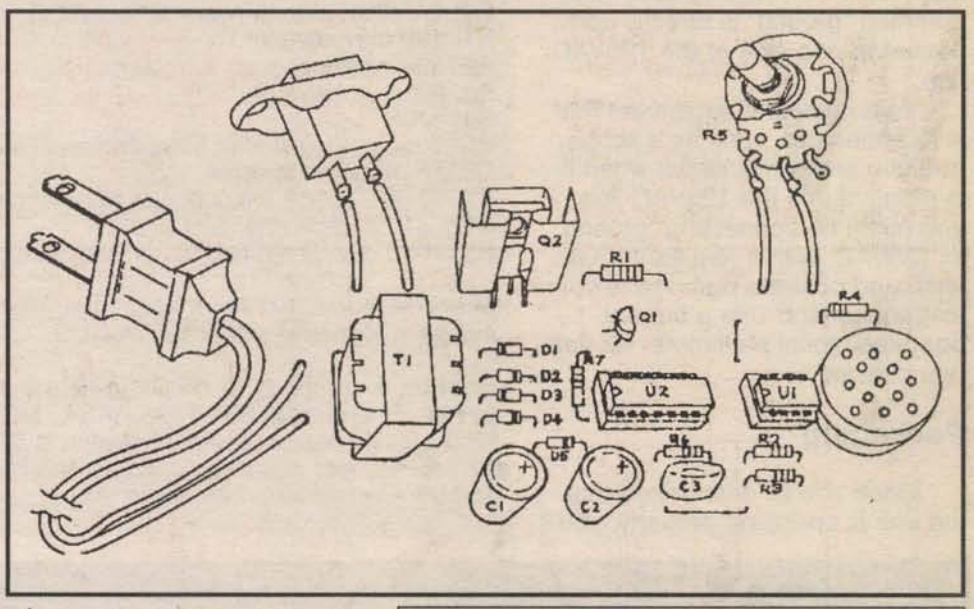


Figure 7: Parts Placement Pictorial

If you build the project from scratch, a printed circuit board is not required, but recommended. All parts, as described in the Parts List, are relatively common parts, but some (crystal microphone, triac, heatsink, 5 megohm potentiometer) might have you searching from several suppliers. My advice: Buy the kit!

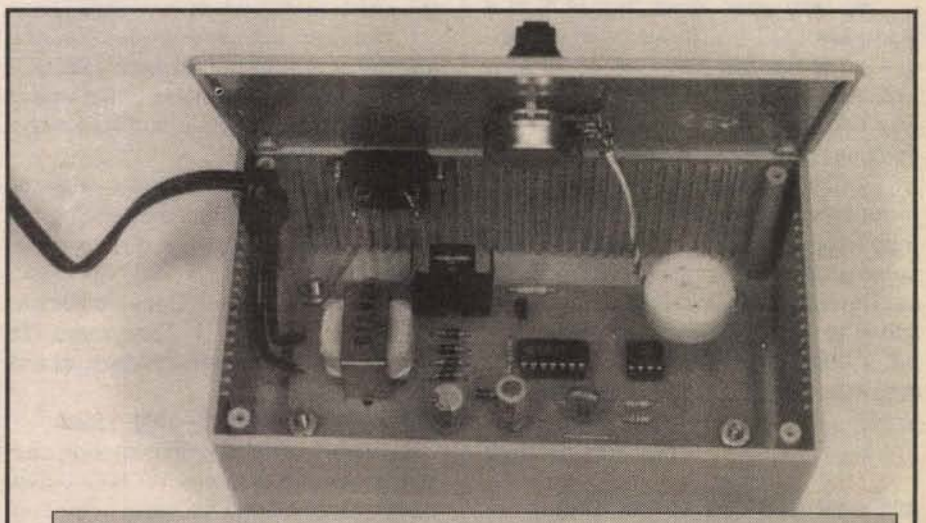
During assembly, you should connect the off-the-board parts (AC socket, potentiometer and microphone) temporarily to check out the proper operation of the unit. After checkout, you can assemble it into a cabinet of your choice.

Testing/Troubleshooting

Testing is easy enough. Plug a 120VAC lamp with its switch ON (no more than 300 watts) into the socket of the Sound-Operated AC Switch. Now plug the project into the 120VAC line, taking proper precautions to NOT touch the etched part of the circuit board, or any exposed leads.

Each time you clap your hands, the light should alternately go ON and OFF. Adjust the potentiometer for the necessary sensitivity at the distance you expect to use when clapping. I found I needed maximum sensitivity (full resistance) for reliable operation from about 12 feet away. I also found I could increase the sensitivity by adding a 2.2 megohm resistor in series with either potentiometer lead.

If the unit does not work, ***UNPLUG IT***, and examine the parts to see that none were



All circuitry fits inside the cabinet except for the potentiometer mounted on the cover.

installed "backwards" from the pictorials. Make sure the integrated circuits were not plugged into their sockets facing the wrong way. Look at your solder joints to see that they look good. Compare with the printed circuit layout (Figure 6) to be sure there are no solder bridges where there shouldn't be.

Beyond that, troubleshooting gets into testing for voltage based on the schematic. Bear in mind, however, that this circuit, although a transformer is used, is NOT isolated from the 120VAC line! The common "ground" is directly connected to one side of the 120VAC line.

If you use test equipment that is AC-operated, such as a scope, and you probe this circuit when it is plugged into the 120VAC line, you might be connecting "ground" to 120VAC, with a resultant bright flash and possible damage to your test equipment! Use a battery-operated digital multimeter for voltage checks.

Packaging

Once you've determined that the unit is operating properly, you'll want to package it so the AC voltage is not exposed. The Graymark Model 1503 plastic cabinet is ideal for this. The plastic material "works" easily with a drill, fine saw, or file.

As shown in the photos, I chose to mount the outlet socket on the back, and the sensitivity control on the top panel. Some drilled holes in the top panel directly over the microphone allow your clapping sound to get through to the microphone.

Summary

Although limited to use with resistive AC devices not exceeding 300 watts, the Sound-Operated AC Switch can be used almost anywhere 120VAC power is available, and a device switch is not conveniently nearby. It is inexpensive, reliable, and the "remote control" consists of merely clapping your hands! **NV**

Sound-Operated Switch

Parts List

All resistors 1/4-watt 10% carbon film
C1, C2: 470uF, 16V electrolytic capacitor
C3: 0.1uF capacitor 16V capacitor
D1-D5: 1N4002 silicon diode, 1 amp, 100 PRV
Q1: 2N3906 PNP general-purpose silicon transistor
Q2: 6A 400V triac (Mouser 519-Q4006L4 or equiv.)
R1: 180 ohm resistor
R2: 33K resistor
R3, R7: 10K resistor
R4: 470K
R5: 5 megohm 1/2-watt potentiometer (Mouser 31VA605)
R6: 15 megohm resistor
T1: 12.6VCT .06A small power transformer (Mouser 41PG006)
U1: 741 opamp integrated circuit
U2: 4013 dual D flip-flop integrated circuit

Miscellaneous: Crystal microphone, eight-pin socket, 14-pin socket, heatsink for Q2, AC line cord, AC socket, 12-inches solder, and instruction manual.

Source: A complete kit of all the above parts is available from **Graymark International, Inc.**, Box 2015, Tustin, CA 92781. Phone: **800-854-7393**. VISA, MC, AMEX,Discover cards accepted. Web site: **http://www.labvolt.com**. Kit Model 147P Sound-Operated Switch is $13.95. Model 1503 Plastic Box and Cover (inside dimensions 5.71- by 3.35- by 1.97-inches) is $3.75. Shipping and handling for orders under $50.00 to 48 states is $4.00; FREE for orders over $50.00. CA residents add sales tax.

Continued from page 63

TECH FORUM

I assume you are running on a 386 or better machine. These machines can run in a "protected" mode. This protection is what is giving you the problem.

In DOS, you can talk directly to the hardware. You are in what is called, ring zero. When you run in a DOS box in Windows, you are running in ring 3. You cannot talk directly to the hardware. Instead, you talk to a piece of software called a virtual device driver (VXD) that sits between what your program thinks is the printer port and the printer port itself.

Be very clear about this: DOS in a Windows DOS box (full screen or windowed) is not the same as booting to DOS and running. Look at it this way. If you can have multiple DOS boxes, you must be running a virtual DOS.

VXDs of different operating systems operate differently. You may think that a piece of hardware will operate the same under any operating system — not so. The VXDs are different. So, one solution is to write a new printer port VXD. I got a book on writing VXDs and quickly gave that idea up! The better solutions are above.

Ed Jensen
Via Internet

ANSWER TO #1982 - JAN. 1998

All Motorola DPC series and MicroTAC series flip phones use the following eight-pin connections.

1. Logic ground. **2.** Ext. 7.5V. **3.** TRU data line. **4.** CMP data line. **5.** RTN data line. **6.** Audio ground. **7.** RX audio OUT (speaker). **8.** TX audio IN (microphone).

Pin 1 is furthest to the left when looking at the back of the phone with the battery removed.

Joe Grand

ANSWERS TO #1983 - JAN. 1998

All CCTV cameras have a baseband video output, which should be viewable on any monitor or VCR that has a "video in" jack. Normally, these jacks are RCA for consumer equipment, but you can get a BNC to RCA adaptor at Radio Shack.

However, the camera you have may have other problems. This model (all 1000 series) is a very old camera with a vidicon tube for its pick-up device, and in all probability it has gone bad.

In normal use, they were replaced every couple of years, but they also go bad if kept unused in storage due to gases building up inside.

Dominic Barber
Tarrytown, NY
dominic.barber@worldnet.att.net

ANSWERS TO #1983 - JAN. 1998

While I can't offer information specific to your RCA model TC 1000/02L closed circuit video camera, I can suggest a couple of things that may be of some help.

You said the camera has a single BNC output connector, but failed to mention if the camera has a power connector or not. If you have ONLY a BNC output connector, then DC power (usually 12 VDC) is being supplied to the camera on the same coax as carries the video output.

To use such a camera, you will need a special kind of power supply that can filter the video signal from the DC voltage it supplies. If the camera has a separate power jack and you're sure you are supplying the correct polarity and voltage, you can try connecting the camera's output to the video input of a VCR. If you still get no picture or just a flicker when the camera's power is applied, the camera may be bad.

John McMichael
Laramie, WY

ANSWERS TO #1983 - JAN. 1998

Your RCA closed circuit video camera has composite video output. In order to view video, you will need a video monitor. An ordinary TV won't work, nor will a computer monitor. Try MCM Electronics, they have reasonable prices on security/video equipment.

Dean Solorzano
Oceanside, CA

ANSWERS TO #1983 - JAN. 1998

You need a frequency "up-converter," not a game adaptor.

The Radio Shack video RF modulator (part #15-1283) converts your camera's standard 6 MHz output signal up to the standard channel 3 or 4 input frequency of 60 to 66 MHz channel 3, or 66 to 72 MHz channel 4.

You can purchase these units minus the power supply and box for around $5.00 surplus or Radio Shack sells the complete unit for $30.00.

You will also need to convert the BNC output on the camera to a standard TV coax cable, or purchase a chassis-mount fitting from Radio Shack (part #278-212) replacing the BNC fitting entirely.

This setup works both on black and white and color cameras, and will convert either signal for display on black and white or color TV sets.

Chris
Bieber, CA

ANSWER TO #1986 - JAN. 1998

In the July '97 issue of *Nuts & Volts*, there was an article titled "Printer Port Oscilloscope" by Robert Davis. Robert provides a schematic and board layout along with the program and parts list with sources. The total dollar amount for the parts is $87.64.

There are also *Nuts & Volts* advertisers that sell computer scopes. One vendor is **Bach Electronics (937-435-7793)** that sells a ready-made unit for $100.00. Another is **Allison Technology Corp. (1-800-980-9806)** that sells multiple units, starting at $189.00.

Douglas Mooney
Bronx, NY

Continued from page 104

New Product News

you where to find the necessary equipment, how to choose the proper equipment, and build your communications system. It also outlines ways to keep in touch with your friends using simple radio equipment without having to take a radio license test of any kind.

Survival Communications helps you build and setup your systems using emergency power sources, many types of inexpensive solar power systems, small generator systems, and back-up emergency battery systems that work when the power grid goes down. Many other unusual alternate power sources are thoroughly covered.

Survival Communications also covers building and using inexpensive satellite radio systems that can be powered by alternate power sources, solar, wind, generator, or battery systems.

The book contains 12 full chapters, plus a supplement listing equipment, and information sources (200 pages). *Survival Communications* sells for $20.00 plus $4.00 shipping by Priority Mail.

For more information, contact:

UNIVERSAL ELECTRONICS, INC.
4555 GROVES RD., STE. 12
DEPT. NV
COLUMBUS, OH 43232-4135
614-866-4605 FAX: 614-866-1201

MODEL TMA-K THERMOCOUPLE MODULE

Amprobe Instrument announces the release of their Type K Thermocouple Module, model TMA-K.

The TMA-K expands the capability of any digital multimeter with DC millivolt resolution and allows direct measurement of temperature possible. The TMA-K plugs into a DMM and converts the output of the K-Type thermocouple's signal to a 1 millivolt DC per °C of °F signal that is displayed by the DMM.

The user can select the temperature to be displayed in °C of °F by the slide switch on the module. The temperature measurement range can be expanded up to 1830°F (1000°C) using any properly rated K-type thermocouple.

The TMA-K comes complete with thermocouple, model TPK-56, for temperature measurements from -40°F to +400°F (-40°C to 204°C), nine-volt battery, and instructions.

For more information, contact:

AMPROBE INSTRUMENT
630 MERRICK RD., P.O. BOX 329
DEPT. NV
LYNBROOK, NY 11563
516-593-5600 FAX: 516-593-5682

200-WATT LOW-PASS FILTER

MFJ announces the MFJ-702 200-watt low-pass filter. It will reduce your transmitter harmonics by 50 dB for only $24.95!

These troublesome harmonics could be the source of interference to your neighbor's TV, radio, VCR, telephone, cellular phone, computer, garage door opener, video game, baby monitor, remote control toys, and other devices.

SWR is below 1.5 to 30 MHz into 50 ohms. It's a perfect match for barefoot transceivers — handles 200 watts with less than 0.5 dB insertion loss. Attenuation is 50 dB at 54 MHz. The small size 6 x 1 x 1-1/2 inches fits anywhere. It has SO-239 connectors and handy mounting tabs.

For more information, contact:

MFJ ENTERPRISES, INC.
300 INDUSTRIAL PARK RD.
DEPT. NV
STARKVILLE, MS 39759
1-800-647-1800
FAX: 601-323-6551
http://www.mfjenterprises.com

PLM-2-PK POWER METER

The PLM-2-PK Power Meter is an electronic instrument used to measure parameters associated with power consumption by an electrical load that is normally operated from a 60 Hz, 120, or 240 volt, single-phase power line.

The PLM-2-PK Power Meter measures true RMS voltage and current; true power; and peak voltage, current, and power.

This meter also calculates volt-amps and power-factor, and measures time and watt-hours.

Connections to the PLM-2-PK are via a rear panel terminal strip. The range of measurements covers the full capability of the 240 volt, 30 amp single phase environment. Current is sensed by an internal .005 ohm shunt resistor.

A Liquid Crystal Display provides a visual output to the operator. Two front-panel pushbuttons allows sequencing through the different displays of values. All measurements and calculations are updated at .5 second intervals. An RS232 option is available which outputs all the measurements and calculations, simultaneously, as an ASCII string for subsequent logging into a computer serial port.

The PLM-2PK Power Meter is a new product and the price is $967.00.

For more information, contact:

ELECTRONIC PRODUCT DESIGN, INC.
2145 DEBRA DR., DEPT. NV
SPRINGFIELD, OR 97477
1-800-616-5521

GUARDIANANGEL™ LIGHTNING SURGE PROTECTOR

The MFJ-270 GuardianAngel™ Lightning Surge Protector will safeguard your expensive radio equipment from damaging static electricity and lightning induced surges. MFJ's ultra-fast gas discharge tube safely shunts up to 5000 amps of peak impulse current harmlessly to an independent ground connection.

The MFJ-270 presents a constant 50-ohm impedance to your transmission line. It has an SWR less than 1.1:1 and an insertion loss of less than 0.1 dB. The MFJ-270 can be used up to 1000 MHz and handles up to 400 watts PEP.

The GuardianAngel Lightning Surge Protector has SO-239 connectors and works with all types of coax fed antennas. It is made of heavy duty steel with quality connectors and components. The ultra-fast gas discharge tube is replaceable.

The price of the GuardianAngel Surge Protector is $29.95.

For more information, contact:

MFJ ENTERPRISES, INC.
300 INDUSTRIAL PARK RD.
DEPT. NV
STARKVILLE, MS 39759
1-800-647-1800
FAX: 601-323-6551
WEB:
http://www.mfjenterprises.com

MFJ-281 CLEARTONE™ COMMUNICATIONS SPEAKER

Plug in this MFJ ClearTone™ communications speaker and bring out communication speech fidelity that you never knew existed. Harsh speech will become pleasant voices.

The MFJ-281 communication speaker will restore the smooth sound of sinewaves that CW naturally generates and make it far easier to copy.

MFJ's exclusive ClearTone communications speaker was carefully designed to improve the intelligibility of speech in the frequency range of 600 to 4000 Hz while reducing undesirable noise, static, and hum.

The MFJ-281 will handle 8 watts, 8 ohms. It comes with a six-foot cord and 3.5 mm mono plug. The speaker measures just 3-3/4 x 3 x 2-1/4 inches. The cost is $9.95.

For more information, contact:

MFJ ENTERPRISES, INC.
300 INDUSTRIAL PARK RD.
DEPT. NV
STARKVILLE, MS 39759
1-800-647-1800
FAX: 601-323-6551
http://www.mfjenterprises.com

MINIATURE DATA RECORDER

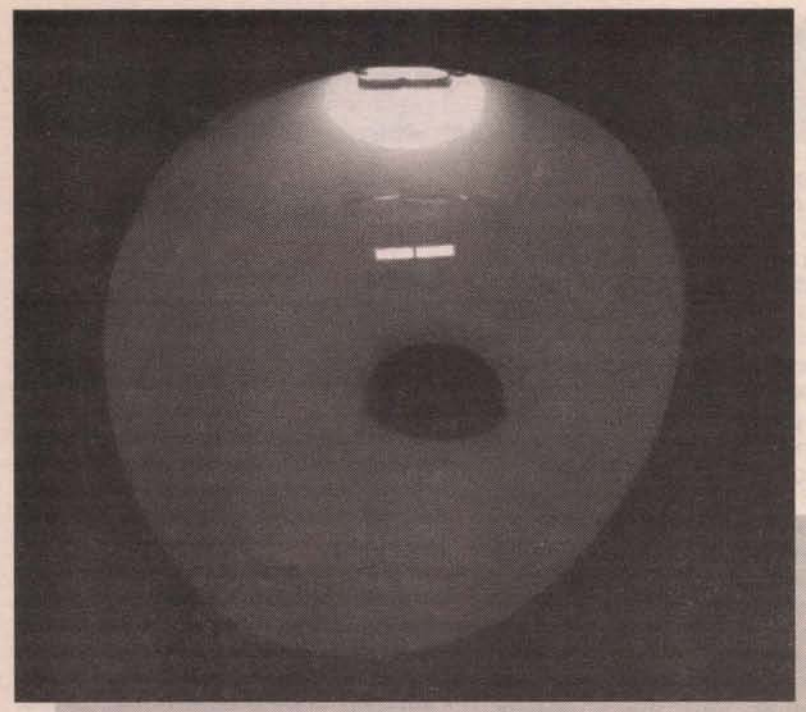
Less than 1" thick and 4" long and weighing just 4 ounces, Model LVOLT816 from B&B Electronics, provides an inexpensive way to record voltage outputs from a variety of sensors. The unit is powered by an internal lithium battery, making it completely self-contained.

Over 16,000 readings from 0 to 3.3 VDC can be logged into non-volatile memory for later downloading to a PC. Typical applications would be monitoring pressure, flow, force or temperature in industrial, commercial, or research processes.

Easy-to-use software to adjust, download, and reset the module is included, as is a complete user's manual and a replaceable lithium battery. Cost is $104.95, complete.

For more information, contact:

B&B ELECTRONICS MFG., CO.
707 DAYTON RD., DEPT. NV
OTTAWA, IL 61350
815-433-5100 FAX: 815-434-7094
E-MAIL: sales@bb-elec.com
WEB: www.bb-elec.com



The Toilight — High-Tech Toilet Light

by Kenton Chun

Have you been suffering from "moon splash-downs" lately? Has prostate trouble resulted in black and blue shin syndrome? Is the marriage on the rocks because of "the seat?" This month's project is for you!

The Toilight will guide you and your spouse to a perfect two-point landing every time. It has no batteries to run out at inopportune and embarrassing nocturnal moments. Its pleasing, nighttime glow is a welcome sight in the gloom of night. It costs less than a penny a day to run and, best of all, it is practically maintenance-free.

The Toilight prototype the author set up has been running trouble-free for an astounding 20,850 hours, or for over two years. Using a typical LED component MTBF of 300,000 hours, a well-constructed Toilight may well last for 30 years!

The heart of the Toilight is a monolithic LED array. The author used a pair of Stanley MU04s — a four-LED array in an epoxy-encapsulated block. Just about any LED array can be used, from a dot matrix to a barograph array. Check the advertiser's pages of this magazine for a wide range of choices. The experimenter may even construct one from discrete components. Although LEDs now come in many colors, only green and blue are considered "bathroom neutral." Because of availability and low cost, the author chose green.

Getting Started

Begin by preparing the LED array(s). The particular array we used had in-line pins. Bend the pins down and solder them so that the individual LED elements are wired in series (Figure 1). Try to use a minimum of solder and heat to avoid damaging the array. Since we used two arrays in the project, we prepared two of them in this fashion and wired them together so that a total of eight LEDs were wired in series. It doesn't matter if the anodes or cathodes are on the left or right as long as they are wired consistently. When the arrays are soldered, test the array by powering it up with a 6 or 9 VAC wall wart transformer.

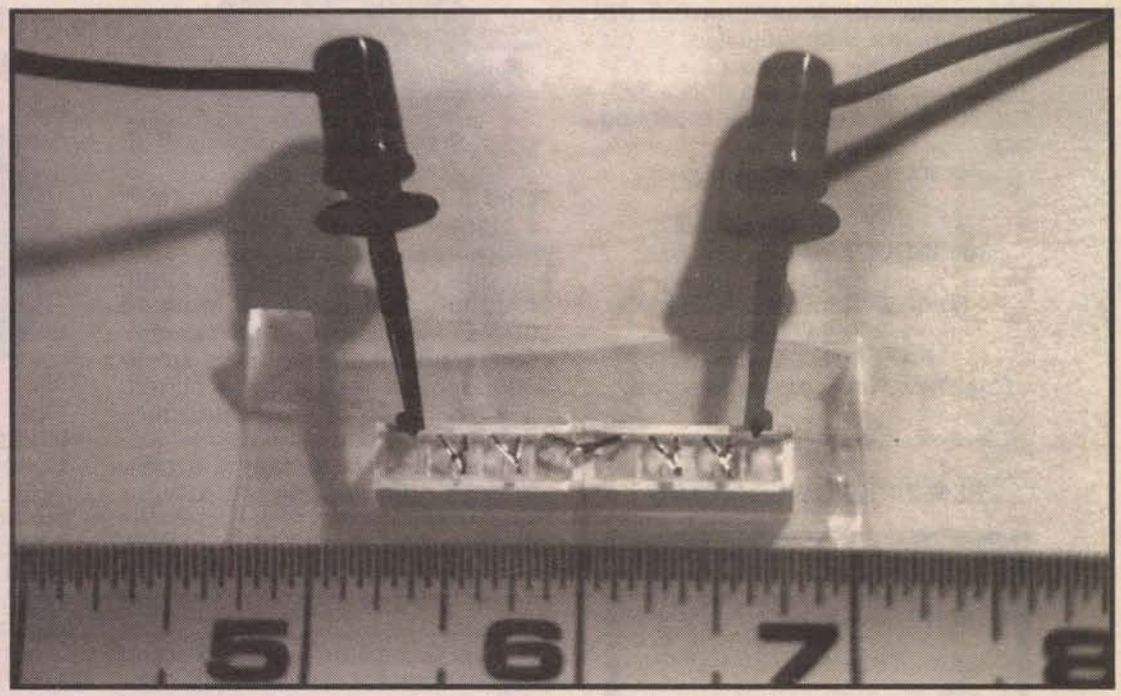


Figure 1: Soldering and Testing the Array

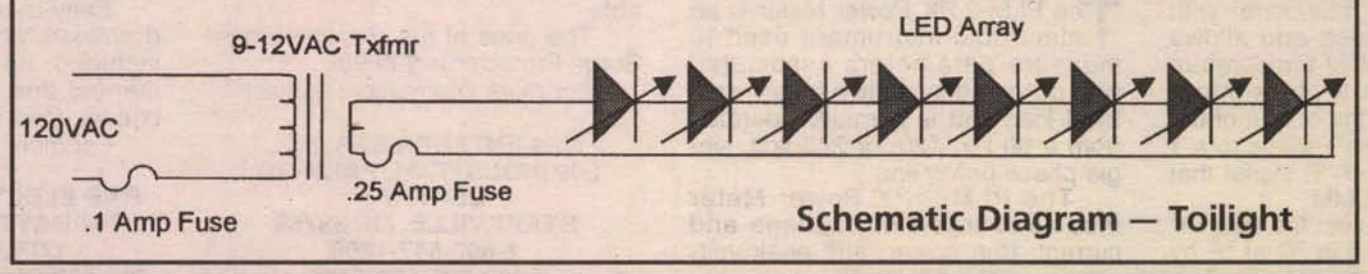
Harsh Environment

The toilet is a harsh environment. The key to making a maintenance-free Toilight is in protecting the array from corrosive cleaners, and the like.

Solder the power leads of the array to a good-quality 20 or 24 GA Teflon-covered wire. Very fine multi-strand is best, but in a pinch, you can use two strands of copper telephone wire. Telephone wire will not last as long, however.

Using a good-quality two-part clear epoxy, epoxy the two arrays together, end to end, and completely cover the exposed soldered leads, including the ends of the power wires (Figure 2). Try not to introduce air bubbles into the epoxy as you mix it, and make the epoxy thickest where the leads enter the LED arrays.

If the epoxy is runny, protect the light-emitting faces of the arrays with scotch tape during the epoxy process, removing it after the epoxy has cured overnight.



Wiring the Toilet

The trick to an aesthetic Toilight installation is in the wiring. Nobody wants to see wires dangling out of the toilet, even at 3 a.m.! After carefully cleaning the toilet, check under the rim at the back for little holes. These holes lead to the down tube located in the center of the holding tank. When the toilet is flushed, the down tube provides additional water flow to the rim of the toilet.

Carefully run the wires through a rim hole at the back of the toilet bowl, and up through the down tube. This may take some patience. It may be necessary to temporarily remove the flapper ball to get access to the wires.

Shut the water supply valve off and flush the toilet to empty the tank. Feed the wires up through the down tube, being careful to bend them so that they will not interfere with the ball flapper valve. Do not run the wires through the flapper valve hole — it will cause the valve to not seat properly! Try not to nick or cut the wire insulation.

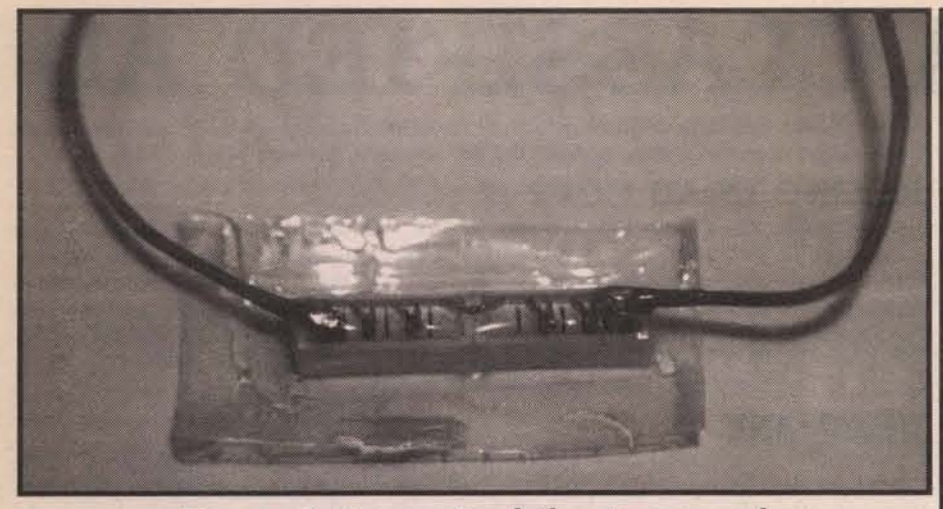


Figure 2: Epoxy Seal the Array and Connecting Wires

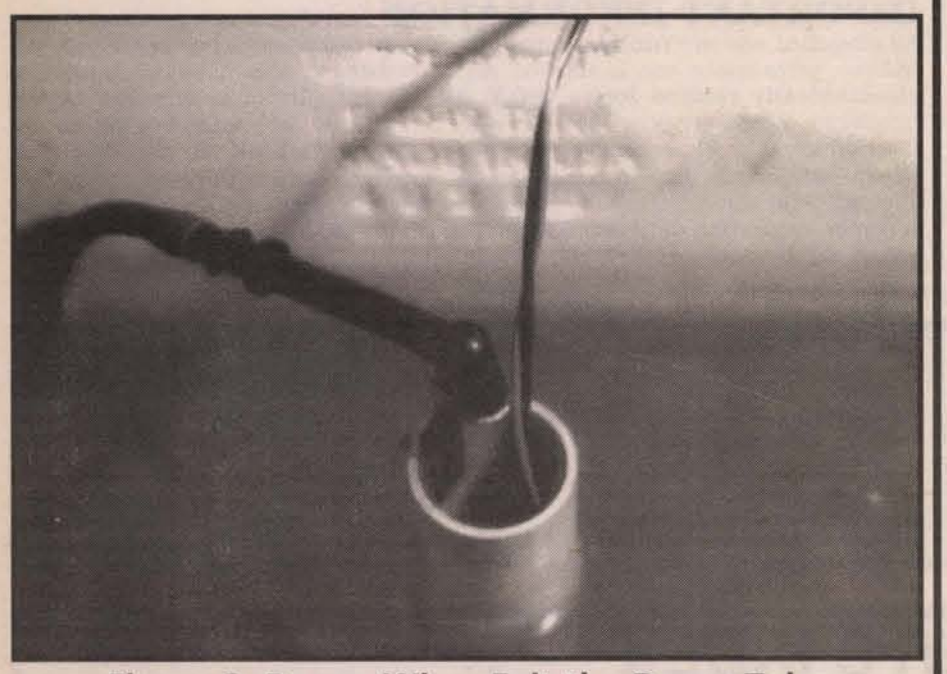


Figure 3: Power Wires Exit the Down Tube

Set the LED array in an appropriate position pointing down at the bowl. Snake the power wires out of the down tube to the back of the toilet tank and out under the edge of the lid (Figure 3).

Fuse the arrays with a quarter amp fuse, and connect it to a 6-12 VAC wall wart. Since the LED array is, in effect, a set of series diodes, it is not necessary to supply the array with DC current. As a general rule of thumb, assume a two-volt drop for each LED element in the array. Divide the transformer voltage by the number of LEDs in your array and try to keep the result as near two as you can. If possible, plug the wall wart into a GFCI-protected outlet.

Since the voltages and power levels used in the project are so low, there is little or no electrocution hazard, but it is best to err on the side of safety.

Enjoy your Toilight. Even if it doesn't save your marriage, it will provide you with a unique powder-room experience. You may even want one in every bath in the house!

Conclusion

The concept of a toilet night-light may seem ridiculous – until you actually have one for a little while. Then you will wonder why they don't build them into the toilet to begin with. Try the ultimate test and put one in. If your spouse is not impressed after only a week, pull the plug and watch what happens.

Remember to have fun, whatever you do! **NV**

Parts List

2 - Stanley Green 4-LED arrays (or equivalent, *see text*)
5' - Teflon multi-strand 20-24 GA wire
1 - 6-12VAC wall wart transformer
1 - .25 amp fuse
1 - .1 amp fuse or GFCI outlet (see text)

Barograph LED displays and discrete LED components are available from many parts distributors in *Nuts & Volts*. See the advertisements in this issue.

Electronics Q & A *(Continued from page 77)*

enable/disable" and select disable. Save the new settings and reboot the system. In some cases, the built-in graphics are auto sensing, which means the motherboard will detect the presence of a plug-in video card and disable the on-board video controller. Owners of Pentium motherboards don't have to go through this procedure. Simply plug the new video card into a PCI slot and the Plug-'n-Play BIOS will change the settings for you.

Notebook HD Upgrade

Q. I acquired a free notebook computer in a trade deal. The problem is that the only hard disk that I can get to work with this PC is the original 20 MB drive that came with the machine. I've tried replacing it with other 2.5-inch hard disks, but then the notebook won't power up. I think the bigger drives draw more current than the notebook can supply. Is this true, or is the notebook in need of repair?

Casey Rhoton
via Internet

A. *It could be that the power supply is too weak to pull the heavier load, but I doubt it. Judging by the size of the original hard disk, I suspect this is a very old notebook, most likely pre-1990. Back in those days, a lot of shortcuts were made to scrunch a desktop PC into a briefcase. One of the frequently-used tricks was to burn-in the hard disk parameters into the BIOS so that battery life could be prolonged by powering down the drive when not in use (nowadays that's done using "Green" technology built into the CPU chip set). This is why you can't upgrade to a different drive – the parameters don't match those in the BIOS. I don't know of a way around this unless you can find a driver for the new hard disk that'll override the BIOS. Maybe one of our readers can help.*

Needs Book On Microcontrollers

Q. I wonder if you can suggest an intelligent beginner's guide to microcontrollers. Ordinarily I can pick up new subjects on my own, but Michael Predko's *Programming and Customizing the PIC Microcontroller* has me snowed, even though I have a pretty good electronics background and a copy of *The Art of Electronics* (Horowitz & Hill) in hand!

Peter Martin
via Internet

A. I wrote a beginner's guide on the MC68HC11 that will tell you everything you want to know about Motorola microcontrollers (*Microprocessor Design Made Easy*, published by AMS, 305-784-0900; $35.00, includes software), but you need something geared more to the PIC series. I suggest the *Microcontroller Beginner's Handbook* by Lawrence A. Duarte; $18.95, $15.16 from Amazon Books (http://www.amazon.com). I've never read it, but the reviews I've seen say it's a gem for neophyte PIC users.

MAILBAG

Dear Mr. Byers:

In the Nov. '97 issue, you made some statements about speaker wires that I agree with very much, and one that I take issue with. I agree that "Monster Cable" is not required for any personal entertainment system that is intended for use in the home. However, at 60 Hz, you state that 90% of the current flows through the 10% region on the outside of the conductor. Not so. This seemed to be way off the mark to me, so I did a little research and found a detailed set of formulas that allows one to calculate the depth in any conductor that current flows. An approximation formula was also given for copper conductors which is much simpler.

$$\frac{3.5}{\sqrt{f}}$$

At 60 Hz, the depth into a copper conductor in which conduction is able to take place is 0.452 inch. So at 60 Hz, a conductor would have to be larger than twice that, or 0.904 inch before a region void of current would develop in the conductor's center. At 15 KHz, the penetration depth decreases to only .029 inch, so any conductor larger than .057 inch (AWG 15) would start to have a region in the center void of current at that frequency. Until a region void of current develops, the "skin effect" isn't a factor, and the AC resistance is roughly equal to the DC resistance. It's apparent that the higher frequencies are the ones that are of concern when it comes to skin effect. And yet, the reason quoted as to why one should switch to "Monster Cable" is "To get better low-frequency response." So what factor does a larger cable cross section give you at 60 Hz if skin effect is not a factor? Basically, less cable resistance which delivers more power to the load with less loss in the cable itself. In the final analysis, speaker dynamics and amplifier design have much more to do with the fidelity of the audio than the cable that connects them. Please understand that I'm not trying to be critical here, I'm just trying to dispel some of the misconceptions that abound in the audio realm.

Arlen Raasch
via Internet

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TYPE or PRINT your **ELECTRONICALLY RELATED** ad copy **CLEARLY (not all caps)** on a separate piece of paper. Spell out words when submitting handwritten copy. Calculate the number of words and multiply it by the appropriate rate (see RATE PER WORD section). Include any charges for **bold** and/or CAPPED words, any artwork costs that would be applicable, and/or costs for boxing your ad (explained below). Choose the appropriate classification for your ad(s) to appear in (see below). If no classification is indicated, it will be placed in Misc. Electronics or wherever we deem most suitable. **Enclose your name, address, phone number, and *Nuts & Volts* account number from your mailing label** (if available) for identification purposes. Include full payment — **CLASSIFIEDS RUN ON A PRE-PAID BASIS ONLY** — and mail your completed order to:

NUTS & VOLTS MAGAZINE, 430 Princeland Ct., Corona, CA 91719.

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You may fax in ad copy or changes before the closing date (5:00pm on the 10th) at 909-371-3052 using MasterCard or Visa. Include credit card expiration date, the name that appears on the card, a daytime phone number, and your *Nuts & Volts* account number. Ads without credit card information will not be listed as received until payment is received in full. **WE DO NOT CALL OR FAX BACK VERIFICATION OR QUOTES OF FAXED-IN ADS.** For verification of faxed-in ads, please call 909-371-8497.

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All classified ads are running copy only. No special positioning, centering, dot leaders, extra space, etc. is allowed. All advertising in *Nuts & Volts* is limited to **electronically related items ONLY**. All ads are subject to approval by the publisher. We reserve the right to reject or edit any ad submitted. We do not take ad copy or changes over the phone. We do not bill for classified ads. Repeat ads or ads run in multiple classifications within the same issue are allowed. Paid subscribers may run ads at the 60¢ rate only through their subscription expiration date. **NO REFUNDS**. Credit only. No credit for typesetting errors will be issued unless you *clearly* print or type your ad copy.

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Rubber Boot Included

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$19.00 any qty

General

Display: 3-1/2 Digit LCD, 21mm Figure Height with Automatic Polarity
Overrange Indication: 3 Least Significant Digits Blank
Temperature for Guaranteed Accuracy: 23°C±5°C RH<75%
Temperature Ranges:
Operating: 0°C to 40°C (32°F to 104°F)
Storage: -10°C to 50°C (14°F to 122°F)
Power: 9V Alkaline or Carbon-Zinc Battery(NEDA1604)
Low Battery Indication: BAT on Left of LCD Display
*Dimensions:*188mm long x 87mm wide x 33mm thick
Net Weight: 400g

DC Voltage (DCV)

Range:	*Resolution:*	*Accuracy:*
200mV	100µV	
2000mV	1mV	
20V	10mV	±(1%rdg+2dgts)
200V	100mV	
1000V	1V	

Maximum Allowable Input: 1000V DC or Peak AC.

DC Current (DCA)

Range:	*Resolution:*	*Accuracy:*
200µA	100nA	
2000µA	1µA	
20mA	10µA	±(1.2%rdg+2dgts)
200mA	100µA	
10A	10mA	±(1.2%rdg+2dgts)

Overload Protection: mA Input. 2A/250V fuse.

AC Voltage (ACV)

Range:	*Resolution:*	*Accuracy:*
200V	100mV	±(1.2%rdg+10dgts)
750V	1V	

Resistance (Ω)

Range:	*Resolution:*	*Accuracy:*
200Ω	100mΩ	
2000Ω	1Ω	
20KΩ	10Ω	±(1.2%rdg+2dgts)
200KΩ	100Ω	
2000KΩ	1KΩ	
20MΩ	10KΩ	±(2%rdg+10dgts)

Maximum Open Circuit Voltage: 2.8V

Diode Test
Measures forward voltage drop of a semiconductor junction in mV test current of 1.5mA Max.

ohFE Test
Measures transistor hFE.

Frequency Range: 45Hz-450Hz
Maximum Allowable Input: 750V rms
Response: Average Responding. Calibrated in rms of a Sine Wave.

CAT NO	DESCRIPTION	PRICE
9300G	Rugged High Quality DMM with Rubber Boot	$19.00

Switchable Scope Probe Sets

(Selectable X1/Ref/X10)

These high quality scope probe sets are for oscilloscopes up to 60MHz (model HP 9060) or 150MHz (model HP9150). Both sets include a handy storage pouch and include an IC test-hook adapter for the probe. The BNC connector rotates to avoid cable tangle or kink. Cable length is 1.4 meters.

CAT NO	DESCRIPTION	PRICE EACH 1	10	100
HP-9060	Scope Probe Set DC~60MHz	$16.49	$14.49	$11.58
HP-9150	Scope Probe Set DC~150MHz	24.95	21.95	18.62

CCD Camera - IR Responsive

As Low As $85!!

This black and white monochrome CCD Camera is totally contained on a PCB (70mm x 46mm). The lens is the tallest component on the board (27mm high from the back of the PCB) and it works with light as low as 0.1 lux. It is IR Responsive for use in total darkness. It comes with six IR LED's on board. It connects to any standard monitor, AUX or video input on a VCR or through a video modulator to a TV. Works with a REGULATED 12V power supply (11V-13V). Hooks up by connectiong three wires: red to 12V, black to ground (power & video) and brown to video signal output.

Power Supply Regulating Kit for CA-H34 This simple kit is designed to fit onto the back of the CA-H34 CCD camera. It resolves the problem of hooking up the camera to an UNREGULATED supply (which damages the camera) by providing safe regulated power from any 12V-14V DC supply. It also provides regulated 12V DC from a 12V AC source.

CAT NO	DESCRIPTION	PRICE EACH 1	5
CA-H34A	PCB Mounted IRCCD Camera	$99.00	$85.00
A34	Power Supply Regulating Kit	$6.95	----

PM-128: 3-1/2D LCD Digital Panel Meter; PM-129: 3-1/2D LED Digital Panel Meter

Features

- 200mV Full Scale Input Sensitivity
- PM-128 - Single 9VDC Operation
- PM-129 - Single 9VDC Operation
- Decimal Point Selectable
- PM-128 - 13mm Figure Height
- Automatic Polarity Indication
- Guaranteed Zero Reading for 0 Volt Input
- High Input Impedance (>100Mohm)

Specifications - PM-128/PM-129

Maximum Input	: 199.9mV DC
Maximum Display	: 1999 counts (3-1/2 Digits) w/Automatic Polarity Indication
Indication Method	: PM-128 - LCD Display PM-129 - LED Display
Measuring Method	: Dual-Slope Integration A/D Converter System *(cont.)*

(cont.)

Overrange Indication	: "1" Shown in the Display
Reading Rate Time	: 2-3 Readings per sec.
Input Impedance	: >100 Mohm
Accuracy	: +-0.5% (23+-5°C, <80% RH)
Power Dissipation	: PM-128 - 1mA DC PM-129 - 60mA DC
Decimal Point	: Selectable w/Wire Jumper
Supply Voltage	: PM-128 - 9V DC PM-129 - 9V DC
Size	: 67mm x 44mm

Applications Include:

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- Thermometer
- pH Meter
- dB Meter
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- Other Industrial & Domestic Uses

Positive Photo Resist Pre-Sensitized Printed Circuit Boards

These pre-sensitized printed circuit boards are ideal for small production runs. They provide high resolution and excellent line width control. High sensitive positive resist coated on 1oz. copper foil allows you to go direct from your computer plot or art work layout. No need to reverse art.

Single-Sided, 1oz. Copper Foil on Paper Phenolic Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
PP101	100mm x 150mm/3.91" x 5.91"	$2.55	$1.90	$1.70
PP114	114mm x 165mm/4.6" x 6.6"	2.98	2.45	1.98
PP152	150mm x 250mm/5.91" x 9.84"	5.40	3.98	3.60
PP153	150mm x 300mm/5.91" x 11.81"	6.15	4.48	4.10
PP1212	305mm x 305mm/12" x 12"	12.78	10.65	8.52

Single-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
GS101	100mm x 150mm/3.91" x 5.91"	$ 3.90	$2.98	$2.60
GS114	114mm x 165mm/4.6" x 6.6"	4.80	3.49	3.20
GS152	150mm x 250mm/5.91" x 9.84"	8.69	5.98	5.78
GS153	150mm x 300mm/5.91" x 11.81"	10.20	7.20	6.80
GS1212	305mm x 305mm/12" x 12"	18.88	15.73	12.59

Double-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
GD101	100mm x 150mm/3.91" x 5.91"	$ 5.07	$3.68	$3.38
GD114	114mm x 165mm/4.6" x 6.6"	5.95	4.29	3.99
GD152	150mm x 250mm/5.91" x 9.84"	10.47	7.39	6.98
GD153	150mm x 300mm/5.91" x 11.81"	11.95	8.69	8.30
GD1212	305mm x 305mm/12" x 12"	22.09	18.35	14.68

Developer This product is used as the developer on our positive photo-resist printed circuit boards. Includes instructions. 50 gram package, mixes with water, makes 1 quart.

CAT NO	DESCRIPTION	PRICE EACH 1	10	25
POSDEV	Positive Developer	$ .95	$ .80	$ .50

Etching Tank This handy etching system will handle PC boards up to 8" x 9", two at a time. Ideal for etching your PCB's! System includes an air pump for etchant agitation, a thermostatically controlled heater for keeping etchant at optimum temperature and a tank that holds 1.35 gallons of etchant. A tight fitting lid is also supplied to prevent evaporation when system is not being used. Typical etching time is reduced to 4 minutes on 1oz. copper board!

CAT NO	DESCRIPTION	PRICE
12-700	Etch Tank System	$37.95

REDUCES ETCHING TIME!

Etching Chemicals/ Ferric Chloride

A dry concentrate that mixes with water to make 1 pint of etchant, enough to etch 400 sq. inches of 1oz board.

CAT NO	DESCRIPTION	PRICE EACH 1	5
ER-3	Makes 1 pint	$3.50	$2.75

Digital Panel Meters (LCD & LED)

3-1/2 Digit LCD 3-1/2 Digit LED 4-1/2 Digit LCD

PM-328: 4-1/2D LCD Digital Panel Meter

Don't let the prices fool you. These digital panel meters are not surplus, so even if you design them into an ongoing manufactured product, you can be assured of continued availability. These high quality digital panel meters are decimal point selectable with guaranteed zero reading at zero volts input.

Specifications - PM-328

Maximum Input	: 199.99mV DC
Maximum Display	: 19999 counts (4-1/2 Digits) w/Automatic Polarity Indication
Indication Method	: LCD Display
Overrange Indication	: "1" Shown in the Display
Input Impedance	: >100 Mohm
Accuracy	: +-0.05% (23+-5°C, <80% RH)
Power Dissipation	: 1mA DC
Decimal Point	: Selectable w/Wire Jumper
Supply Voltage	: 9V DC
Size	: 67mm x 44mm

Features:

- 200.00mV Full Scale Input Sensitivity
- Single 9V DC Operation
- Decimal Point Selectable
- 11mm LCD Figure Height
- Automatic Polarity Indication
- Low Battery Detection and Indication
- High Input Impedance (>100 Mohm)

CAT NO	DESCRIPTION	PRICE EACH 1	10	25	100	250
PM-128	3-1/2 Digit LCD Panel Meter	$ 9.90	$ 7.09	$ 6.40	$ 5.86	$ 5.25
PM-129	3-1/2 Digit LED Panel Meter	11.49	9.54	8.67	7.95	6.95
PM-328	4-1/2 Digit LCD Panel Meter	19.88	16.40	14.90	13.66	11.93

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NEW PRODUCT SPOTLIGHT

R11 TEST RECEIVER

30MHz - 2GHz

Handheld Receiver

NEW

Optoelectronics is pleased to introduce the all new R11 Nearfield FM Test Receiver. Capable of sweeping 30MHz - 2GHz in less than one second, the R11 can lock onto a 5 watt UHF signal as far away as 500 feet in less than one second, demodulate the signal through its built - in speaker, and display the general band the frequency is transmitting in on its LED indicator. The R11 Test Receiver presents all new performance, features, and capabilities.

U.S. Patent No. 5,471,402

Volume & Squelch Control Knobs

Instruction Indicators:
LED's will illuminate which mode the R11 is configured for.

CI-V and Headphone jacks:
CI-V jack allows for connection to the Scout for Reaction Tune. The Headphone jack connection also allows for external speaker.

Frequency Band Indication:
Displays what band the received frequency is transmitting on.

Built - in Speaker :
Instantly demodulate any receiver frequency between 30MHz - 2GHz (Cellular Blocked).

Hold / Mute Button:
The Hold button allows the R11 to stay locked on the received signal.

Power

Lockout / Lockouts on-off:
The R11 allows for 1000 user activated lockouts.

Shift / Off:
The Shift button controls all of the R11's secondary functions.

Skip / Clear Lockouts:
Press the Skip button to continue sweeping. Clear Lockouts will empty the lockout memory.

$299

MADE IN USA

FACTORY DIRECT ORDER LINE: 800-327-5912

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